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Heating Piping & Air Conditioning

INDUSTRIAL
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MARCH ★ 1947

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

Vol. 103 — Journal Section of the American Society of Heating and Ventilating Engineers

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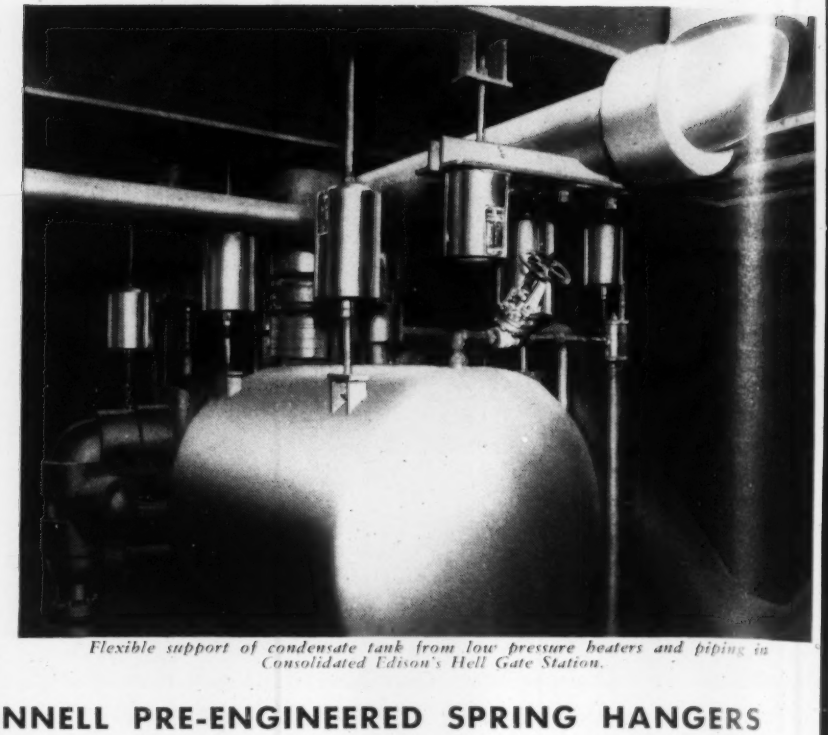
Foundry ventilation problems are discussed in an easy-to-read article by Jim Black and Lester T. Avery on page 71 this month

FLEXIBLE SUPPORT OF PIPING

made easy for you



Flexible support of condensate tank from low pressure heaters and piping in Consolidated Edison's Hell Gate Station.

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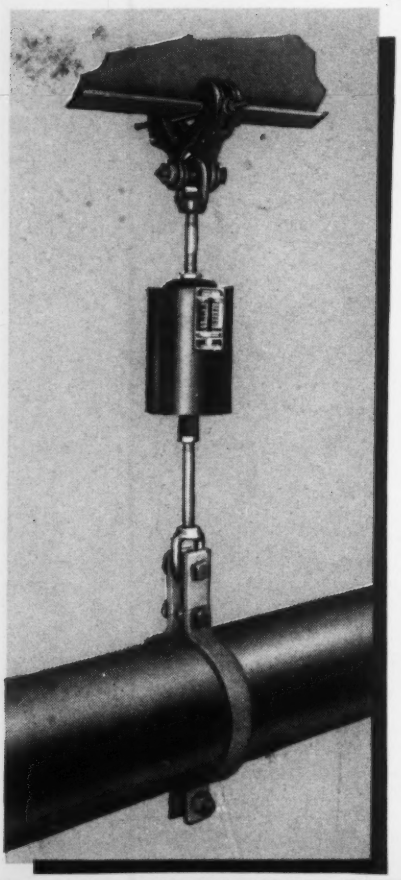

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After computing the load it is easy to select the proper size of hanger from a simple capacity table. The 14 sizes include a load range from 84 lbs. to 4700 lbs.

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- The maximum variation in supporting force per ½" of deflection is 10½% of rated capacity – in all sizes.
- Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.
- Compact – minimum headroom made possible by precompression*
- Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.
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- 14 sizes available from stock – load range from 84 lbs. to 4700 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.
- Unique swivel coupling provides adjustment and eliminates turnbuckle.

*Precompression is a patented feature

Write for descriptive folder on Pre-Engineered Spring Hangers Fig. 268.

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The point to remember (did we hear a groan?)
Is we still build controls and, by golly, we've grown.
If we don't have equipment to sell you, don't sorrow—
"There'll come a day"—and that day is tomorrow.

....thus ends a good-humored booklet in verse, written by John Young of its sales promotion department, being distributed by the Minneapolis - Honeywell Regulator Co.

In some 20 stanzas, the poet describes "the 'impossible' trials that have made reconversion a new-type Inferno (worse than Dante's own version)."

"MAINLINER" FEATURES AIR CYCLE SYSTEM

United Air Lines' new four-engined "Mainliner 300" (Douglas DC-6) offers many innovations in air temperature control and pressure control; it is designed to provide air travelers with "living room comfort" regardless of outside air temperatures while cruising at 15,000 to 20,000 ft. During the winter, interior air temperatures will be held at 68 to 72 deg, and in the summer will range from 74 to 78 deg.

An altimatic, or altitude conditioned, cabin provides low level comfort of hearing and breathing at high altitudes. For example, when the plane reaches 16,000 ft, "cabin altitude" is only 5300 ft; at an actual altitude of 20,000 ft, cabin altitude is only 8000 ft.

Cabin pressurization and temperature conditioning are accomplished through a supply of air from two engine-driven superchargers in the outboard engine nacelles. Hot or cold air—whichever is required to maintain a desired temperature—is passed into the cabin through a system of ducts. Pressure is controlled by an outflow valve.

The heating system incorporates an internal combustion heater equipped with dual fuel and ignition systems.

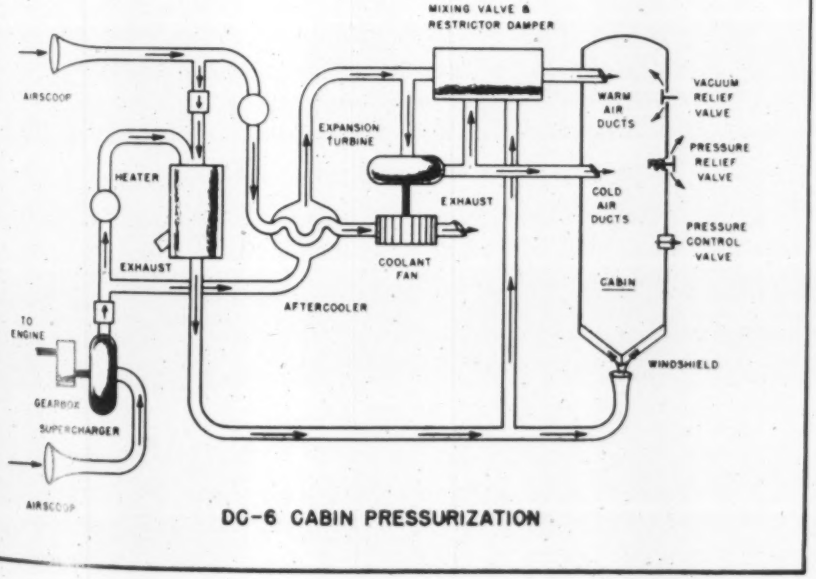
An air cycle refrigerating unit—consisting of an aftercooler, expansion turbine, and axial flow fan—operates in parallel with the heating system to provide cool air when the cabin is pressurized and when ground temperatures range upward to 100 deg.

The ventilating system can deliver unheated, conditioned, outside air to the cabin at a rate of 61 lb per min, or approximately 20 cfm per passenger. Cold air ducts are accessible to each outside seat, adjustable by the occupant.

The interior sound level of the plane is maintained at a low point through use of fiber glass within the plane's skin. Besides reducing the sound level, the material insulates against heat and cold.

Outstanding among the features of the plane is its hot air or thermal anti-icing system to prevent or remove ice formation on leading edges of the wing, tail, and windshield.

Schematic diagram of the air system



DC-6 CABIN PRESSURIZATION

THE EDITOR'S PAGES

MORE GAS FOR EASTERN SEABOARD

War Assets Administrator Robert M. Littlejohn announced February 14 that the WAA real property review board had recommended that the Big Inch and Little Inch pipe lines be sold to the Texas Eastern Transmission Corp. for $143,127,000 for the transmission of gas to the metropolitan area of the eastern seaboard.

Mr. Littlejohn pointed out that the sale of the lines could not be consummated until the Attorney General approved it.

BRAZILIAN APARTMENT BUILDING AIR CONDITIONED

The eye-appealing, modernistic Prudencia apartments building under construction in Sao Paulo, Brazil, is to be completely air conditioned, according to the Trane Co.

38 Units

The air conditioning system involves the use of 38 individual "Climate Changer" units, which offer individual apartment air conditioning for each tenant. Two isolated structures on the top of the penthouse apartments will house the refrigeration and heating equipment; one will contain the compressors and water chillers, while the other will contain the fully automatic oil burners and boilers. A separate building on the ground level will house the administration general power and light switches, main fuel oil tank, and the pump to lift the fuel oil to the auxiliary tank in the boiler room atop the penthouse. All ductwork will be molded or preformed in an asbestos cement. Reciprocating compressors, water chillers, and evaporative condensers are used to supply the chilled water to the cooling coils in the units, and these same coils will receive hot water from the heating system during the winter months.

THE EDITOR'S PAGES

SNIFFLE STOPPERS

New methods of air purification are now being widely tested. If successful in practice, they will reduce airborne respiratory infections, which cause about 35 per cent of all industrial absences due to illness and injury. In crowded New York City, 6 per cent of all working time is lost because of respiratory diseases. Air sterilization methods, used alone or in combination, include ultraviolet lamps, use of glycol vapors, and use of an electrostatic dust precipitator, which knocks down bacteria along with the dust. Interest is currently focussed on protecting places of public assembly; working places have received first attention, and other sites of high infectivity may be treated if current experiments are successful. One point still in question is the extent to which any protection of the working place will help an individual who is exposed to infection at home, in subways, and elsewhere.

Ultraviolet lamps in schoolrooms and hospitals have reportedly cut airborne infection, including mumps and measles, by 25 to 50 per cent. Since the radiation can affect skin and eyes, lamps are usually installed above the head level. Movement of room air over the lamps by ordinary circulation is usually adequate, though bacteria lurking in any dark spots are not destroyed. Most common use of the lamps at present is in hospital operating rooms and nurseries, where they have proved effective. In one large scale installation, 99.5 per cent of the bacteria entering the rooms were reported destroyed by lamps placed in the ventilating system. Crossinfection by the occupants of a room, however, is not prevented by such an installation.

Airborne bacteria may be associated with either dust or water particles. Because of its affinity for water, glycol vapor in the air is absorbed into the particle and kills the bacteria. Glycol vapors are reported to destroy the principal organisms involved in scarlet fever, pneumonia, sore throats, and boils and abscesses, as well as the viruses of mumps, measles, and perhaps certain other infections. British research on protecting air raid shelters has been extended by the U. S. Army commission on airborne infections to determine the conditions for optimum efficiency of the glycol vapors. In general, glycols work with increasing efficiency in increasing humidity. Ideal conditions for a bactericidal concentration of glycol vapor require a temperature between 50 and 80 F and a relative humidity between 20 and 60 per cent. One method of dispersing the glycol depends on passing heated air over disks rotating through a bath of glycol. Another method employs boiling mixtures of glycol and water. In a small unit glycol is evaporated from wicks by means of a heat lamp.

Either triethylene or propylene glycol may be used, depending on the cost consideration and the engineering problems involved. Propylene glycol is said to be bactericidal in a concentration of one part in eight million of air, which is well below the fog point. Triethylene glycol, effective in even smaller concentrations of one part in 400 million, is considerably cheaper, but the margin between the bactericidal concentration and the point where it condenses on cool surfaces is narrower than for propylene glycol. Thus, greater care must be exercised in maintaining satisfactory operating conditions. One installation in a 15 bed hospital ward used $3 worth of propylene glycol in a month, while a four floor bank building used $150 worth of triethylene glycol last winter. Actual efficiency of these installations has not as yet been reported. Other experimental installations are operating in hospital wards, pharmaceutical houses, and office buildings. The statistical data thus acquired are expected to throw further light on the effectiveness of this type of bactericide. The first commercial installations will probably be in combination with other methods of sterilization in pharmaceutical houses, where absolute sterility of air is desired. Use in schools and hospitals, where crossinfection within the room is common, will probably be delayed somewhat by cost consideration. Hospital systems especially must be carefully engineered in order that the recirculated air may be at least as clean as the new air. Glycol is advantageous here because it kills bacteria originating in a room, as well as those entering it, and thus reduces crossinfection within a ward. When glycol vaporization is combined with light oiling of floors and blankets in hospital wards, dustborne bacteria decrease markedly.

Dust Removal Desirable

Because the incidence of airborne bacteria and dust are closely correlated, efficient removal of dust from the air, even without bactericidal treatment, is highly desirable. Electrostatic precipitators have an overall dust removal efficiency of 90 per cent or better and remove even extremely small dust particles. Used for a number of years to protect delicate machinery, foods, and beverages from airborne dirt, they are now recognized as an aid to air sterilization. Acting on the principle of the attraction of opposites, the device draws incoming air through an electrostatic field, where each dust particle receives a positive charge. As the air stream then moves over negatively-charged plates, the dust settles onto the plates, from which it may be hosed. The units may be installed in ventilating systems if the existing space is adequate; the cost is, of course, less for units going into new systems.—*From the Industrial Bulletin of Arthur D. Little, Inc.*

The
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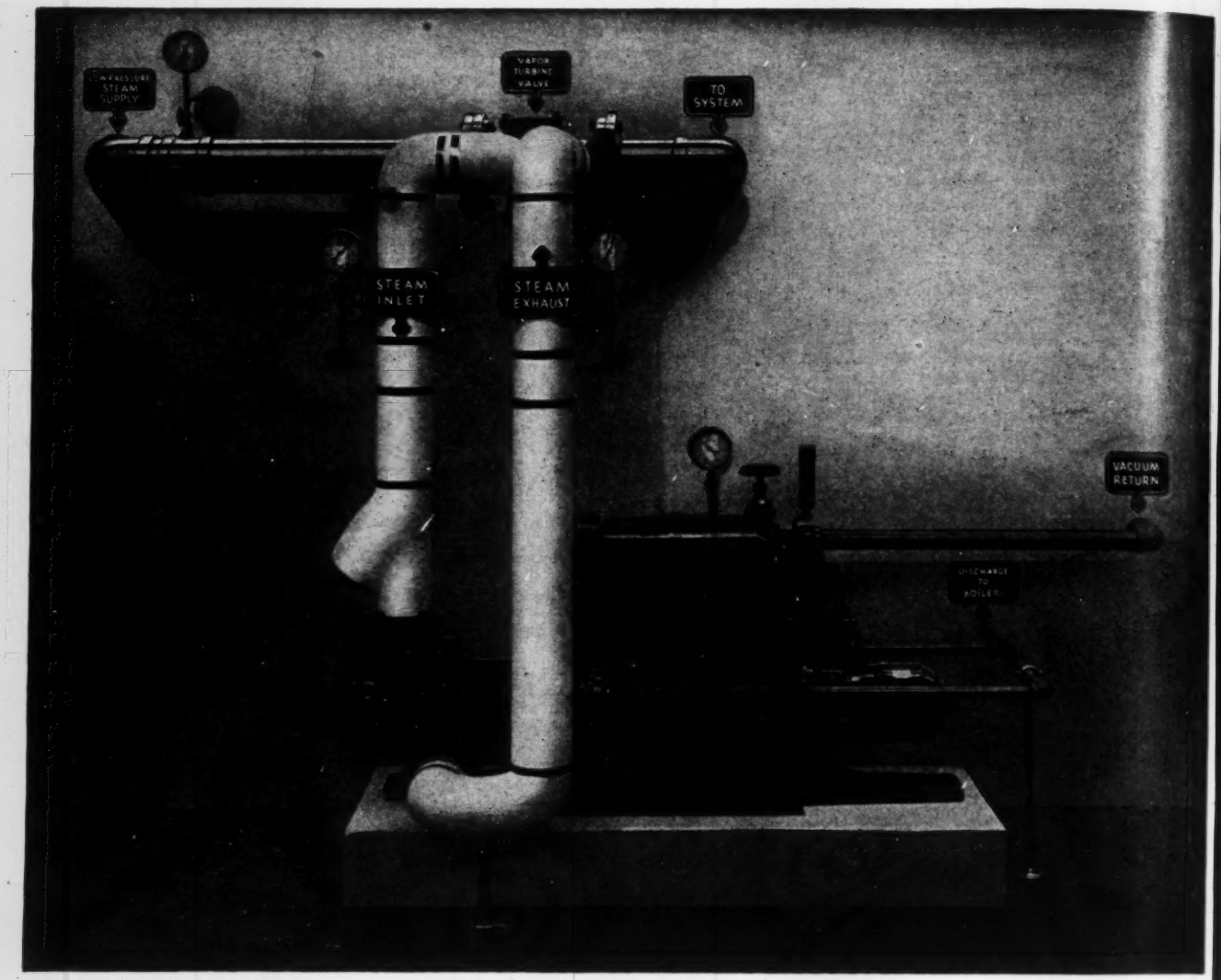
Interrupted Electric Service will not stop this NASH Heating Pump



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

The Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump. Bulletin on request.

THE NASH ENGINEERING COMPANY

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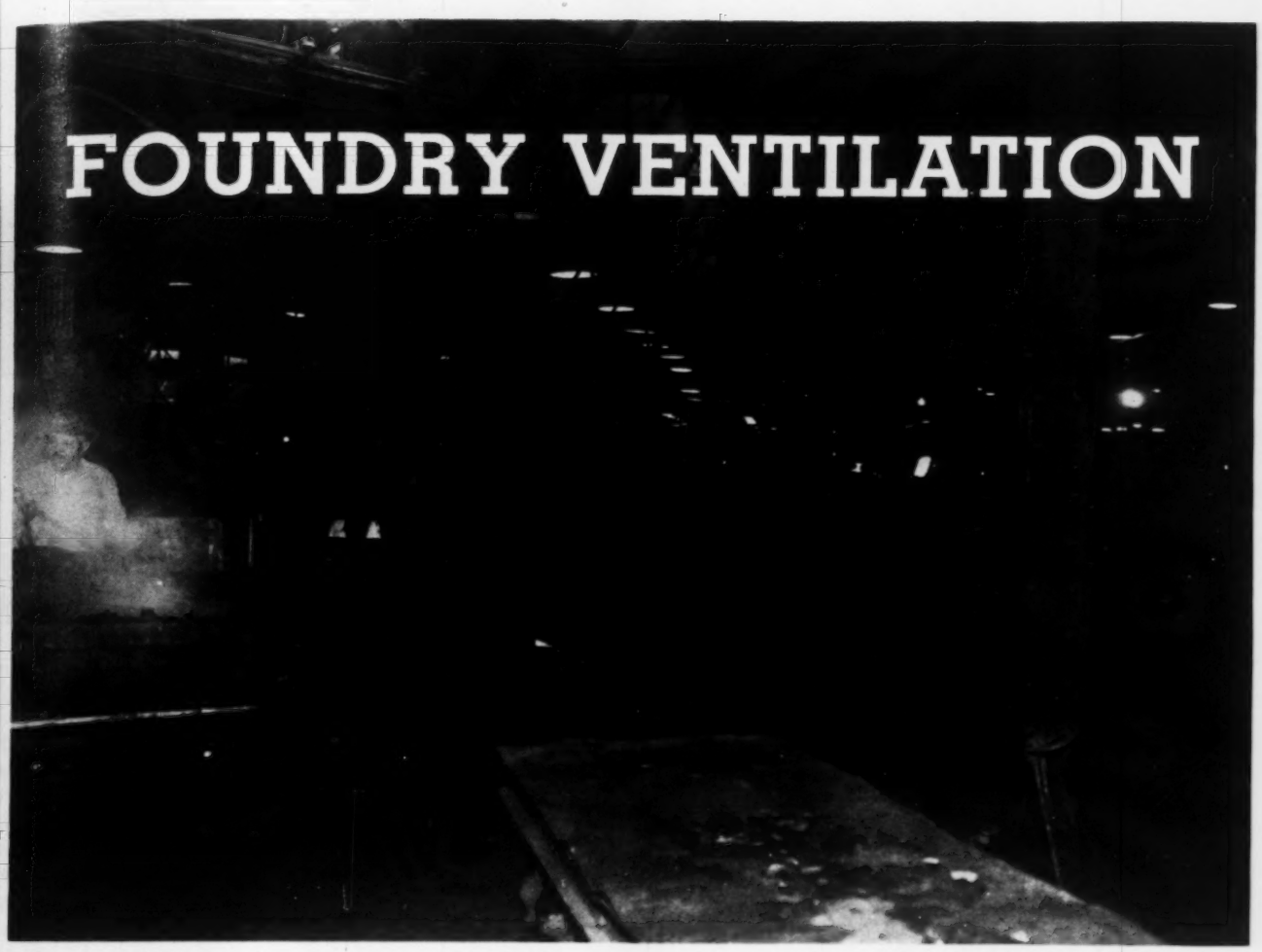
FOUNDRY VENTILATION



What Are the Problems?

By Jim Black and Lester T. Avery
Special Engineer and President
Avery Engineering Company

THIS IS A REALLY tough assignment! We have tried to avoid writing on foundry ventilation for three years. But the idea keeps coming up, just like the idea of trying to climb the highest mountain if you are a mountain climber, for "fools rush in where angels fear to tread." Well, here we are again, and we're going through with it this time . . . . . maybe it'll be fun, who knows?

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First, we'll have to limit the kind of foundries we are talking about to the kind we've worked in—grey iron automotive castings, in what is termed a "mechanized foundry." Prior to getting trapped into doing this job, we visited and inspected a number of foundries of all kinds all over our section of the country. We talked to plant engineers, consulting engineers, safety engineers, college professors, physicians—anybody and everybody who could or should know something about foundry ventilation. There seemed to be a pretty general feeling that most of the money spent to date on ventilation in foundries had been wasted, the results secured being so far short of satisfactory that most of the systems were either inoperative or were being tolerated until they could be removed and new systems installed.

The facts are that foundry ventilation, which must necessarily include heating in the winter and reasonable working comfort in the

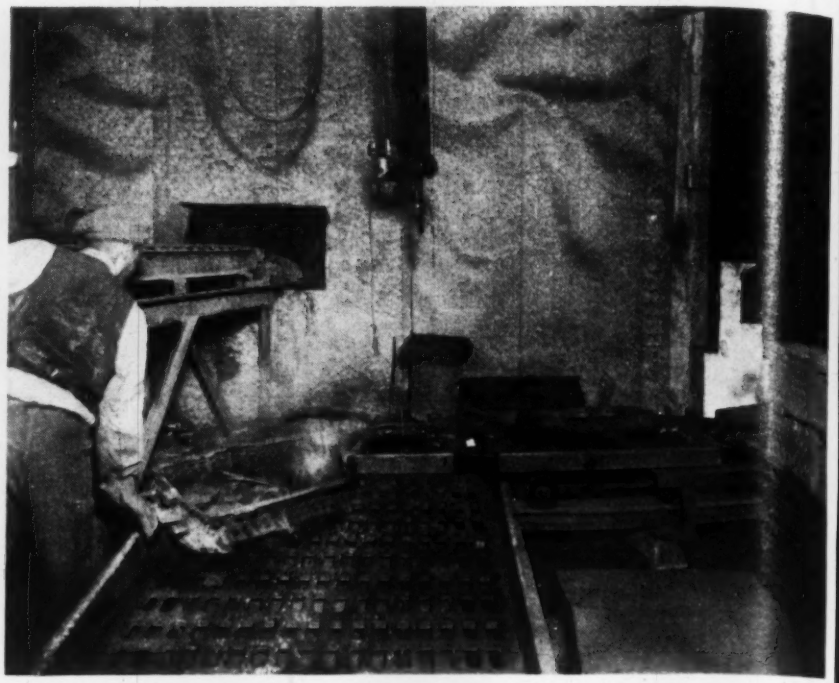
summer, is very difficult, and as Jack Martin says, "I wish it were impossible." If you ask, "Can foundries be properly ventilated?" the answer comes back, "No, not at any reasonable cost." Yet they simply will *have* to be ventilated, someone has to do it, and someone will have to pay for it. You have to mold grey iron castings, and it takes men—good, strong, intelligent men—and foundries have to live as neighbors with other plants and residences in any community.

This article and a following one will disclose not only some of the things that can and have been done right, but will also expose some of the things done wrong. They may inspire some courageous engineer to undertake to do a good foundry job, avoiding those mistakes which have previously been made. If any reader knows of a good production foundry turning out two to 300 tons of grey iron automotive castings in an 8 hr shift and keeping up that rate for two shifts, day after day, month after month, and in which there is a *good* heating and ventilating system, please advise. We'd like to see it.

The Trouble with Dust Counts

The basic problems are simple and recognized and many engineers have gone part way in trying to solve them. First is the health hazard, as silicosis, asbestosis, tuberculosis and other less virulent respiratory diseases have long been associated with foundry work, and many states have tried to set up limits of dust count to protect the worker. The trouble with dust counts is the wide disagreement on what is a safe threshold concentration, and (what is worse) the wide difference in counts taken at the same place by different people. There are as many dust counts as there are counters!

Why foundry ventilation is a tough assignment for the heating, ventilating, and air conditioning engineer is discussed here. A second article will give some specific designs, air quantities, and velocities, and a few operating suggestions



Drag shakeout before installation of ventilation system

Then comes the problem of heat—excessive, burning, radiant heat from molten iron from the time it is poured off the cupola at 2800 F until the casting is cooled and turned over to shot blast for cleaning.

How can you limit and control radiant heat? As soon as it hits something it is converted to sensible heat and that means a general heating up of air, walls, hoods, conveyors, and workers. Did you ever see a man knocking off half solidified sprues from a 300 lb flaming casting mold, working inside a hood, with a steel cart behind him into which he piles the sprues until the cart is full, by which time the cart itself is almost incandescent?

"The Three Thugs"

Smoke in itself is not harmful, but it certainly is a nuisance and is considered an indication of something or other of good ventilation. How can you collect smoke when it is being blown around by the so-called "man cooler"? Then they put still smoking castings in trucks which stand around by the molding lines, or put them on conveyors that travel miles around the foundry spewing out smoke and heat and dripping core sand.

Dirt, smoke, and heat—these are the three thugs the ventilation engineer must catch, they have a whole train of tag-alongs, and they are at their depraved worst in the foundry. You can't control them by waving a wand or talking about so many air changes per hour. Every cubic foot of air that is exhausted has to come from some place, and most foundries are airbound. All air has to be tempered in cold weather, as you can't let zero air blow in through an open door or window to hit a worker on the back of the neck when he is being slow cooked in front by an incandescent casting. If you attack the problem—as many have—by simply adding exhaust fans and systems by the hundred thousand feet you shortly run out of heating capacity to temper such air. Windows have been broken, roofs caved in, and doors ripped off in foundries that were given these astronomical exhaust systems with no provision for supply air when the building was closed up in cold weather.

Yes, it is very difficult, but not impossible, and the foundry owner and manager are going to continue to seek improvement even to the point of perfection, and the heating and ventilating engineer is going to be maneuvered into learning how to do it, even the hard way. We indicate here—briefly—the several separate problems that have to be

Knockout before installation of ventilation system

considered, and our next article will give specific design data, showing quantities of air, types of apparatus, and other details that may help the engineer who gets caught in one of these foundry assignments.

Why Foundries Must Be Ventilated

Foundries must be ventilated because:

1) Employers want to provide good working conditions.

2) The cost of silicosis and allied cases is being charged to that foundry in which the man worked.

3) Excessive heat slows production.

4) Excessive smoke slows production.

5) Unions demand good working conditions for their members.

All of which adds up to the general statement that good working conditions attract and hold good employees, reduce absence from sickness, reduce the cost of manufacturing. Good ventilation and heating are part of good working conditions in the foundry.

Where do we start? We are going to start on the molding line because that's where we did start. The core room may be a problem in some foundries, and the sand mullers and other operations that precede molding are important, but we didn't study these nor have a chance to make any mistakes in them.

We did do a number of molding lines and the first thing we learned —and it isn't in the books—is that the quantity of smoke and heat generated on any line is a function of the *quantity of iron* poured per hour, the size and number of the individual castings on that conveyor line. Simple and obvious, isn't it, but do you know how much air to handle per ton of iron on the line? You do have some dope on air per ton for the cupola, but not for the pouring hood.

In a typical molding line for cylinder blocks for a standard automobile you first have the molders who set the cope and drag and cores together and fill with molding sand. Then the mold travels under the pouring hood, where one or two teams are working continuously pouring the molten iron. There is a lot of heat here, and it reflects from the back wall of the hood. The men would rather work in the open to avoid this reflected heat, so the first thing they do is to ask to have the back of the hood removed. Your hood has to catch and trap the smoke and fumes from the freshly poured casting, and if your air quantities are to be held within reason you should have a back to the hood. First requirement—a non-reflecting hood.

Then the mold rolls into the cooling tunnel where it is easy to trap the gases and smoke. But the man that knocks the sprues off likes to get ahead of his work so he comes back upstream from his sprue station and works through the tunnel. Then he can go outside for a cigarette and rest for half an hour. But the air in that tunnel isn't fit for man nor beast and about noon he claims a headache and goes to the dispensary—mild case of carbon monoxide and sulphur poisoning. If you make the tunnel small enough so a man can't work in it you can't repair your conveyor or carts. If you ventilate it good enough for a man to work you require an excessive amount of air. O. K.—tell the man he can't work in the tunnel.

Then the casting gets to the sprue station where the worker *should* be waiting and you blow the make up air for the tunnel across him into the ends of the tunnel. This is a pretty good place to work, except that as you accumulate sprues in a steel cart it gets hot—especially objectionable in summer.

The mold then rolls back into a section of tunnel for further cooling and smoking and comes to the clamp station. Here again the supply air for that end of the tunnel is blown across the man. Then the cope is grabbed in a hood designed to permit the pneumatic hoist to get above the cart and—in a burst of smoke and heat — the cope is snapped off, rushed over to the cope shakeout, and the fuming casting with its proboscis sticking out of the sand goes back into the cooling tunnel to jel still further before getting to its own drag shakeout hood. The cope shakeout is downdraft and this air is so full of dirt it has to go to a cleaner of some kind, in this case a combination blower and dynamic dust precipitator. The smoke in the cooling tunnel is pretty tough but this can be ventilated with unheated air so we can waste a little excess fan capacity here; no one works in this tunnel.

Then the casting and drag emerge, solid but hot, and drop on to the drag shakeout. The casting is hooked onto the conveyor which takes it to the cooling tower, and from thence to the knockout. The drag is tossed onto a belt conveyor to return to the molding station. There is no particular problem here except to catch the dust and smoke

and heat and still provide access for the men to work in handling the casting and the drag and the gates. The exhaust here is a combination of downdraft and side hood and the air is taken to a cleaner to remove the dirt.

At the knockout the casting is dumped onto a vibrator and the exhaust is downdraft to another cleaner. The supply air is introduced directly above the workers in an effort to give them good clean air to breath as the knockout operation is considered responsible for some of the silicosis hazard. Then the casting is passed onto the shot blast operation, which has been an old and common problem and is handled in many conventional ways. Our interest ceases as soon as we get the casting off the knockout.

That's All There Is to It

Well, that's all there is to it. We've described one line, handling one kind of casting, and one rate. There are seven other lines, all handling different types of castings and at different rates. Then there is an open pouring floor for special job work. The type of work is changed from time to time on any line. The back of a hood on one line may act as a reflector of heat to the man working in the next line. The inevitable man cooler fan blows the dust and smoke and heat away from one man directly over another or scatters it through the foundry. There is no question but what the metal enclosures used for tunnels and hoods aggravate the reflected heat problem. We've seen man cooler fans turned to blow the air across a man at a pouring station and blow the smoke and fumes out of the hood so that the hood and its fan were really handling relatively clean air and the stuff it was supposed to catch was being blown on down the line. It seems to us that the first step is to do a job good enough that the man can work without the portable fans, and then remove them and refuse to permit them to be reinstalled. Either the central exhaust and supply systems should do the job or money should not be wasted on them at all. You just can't use a "few local fans."

Then you have problems that change with the season. In cold weather you still need plenty of air for smoke and dust conveying but not much extra for cooling. Supply air must be balanced against the exhaust and tempered to at least 50 deg and introduced so the worker still gets clean air for breathing.

It seems now that there should be two exhaust systems, one tied in with supply to run the year 'round getting adequate tempered air in cold winter weather from the supply system to eliminate cold draft around doors. The second system would be tremendous in air handling capacity, depending largely on air coming in untreated through open doors and windows for summer cooling. The trouble with this scheme is the refusal of the worker to be satisfied with exhaust only when he is used to having air blow directly on him when he is hot. Why not close up the foundry and condition the air? Here is a spot where evaporative cooling might really do a job. Has anyone done it in a foundry? Where?

Then each individual foundry has its habits of work and the management frowns on any ventilation installation that requires changes in these work habits. The air conditioning engineer that undertakes foundry work can look forward to frustration not experienced in any other branch of this profession. Even if it's good they don't like it! You will see the careful design unbalanced because a casting fell off the conveyor and the hood was in the way—so they rip out part of the side of the hood. Watch out for fires in ducts and hoods from accumulated tars and dusts. They won't clean the ducts! Watch out where you throw your exhaust, as it may short circuit back into your supply. Frustration, here we come!

If you insist on going ahead with this thing, our next article will show some specific designs, air quantities and velocities, and a few operating suggestions. Yes, foundries must be air conditioned! But how?

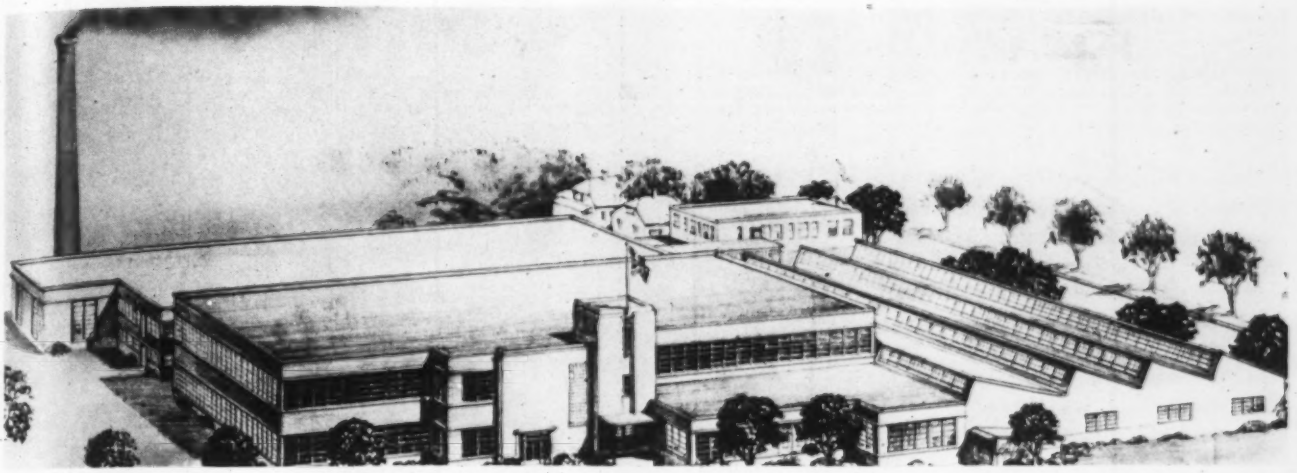
REMA SEES BIG PLACE FOR AIR CONDITIONING IN TELEVISION

Nearly 1000 new standard and FM radio and television stations throughout the country will add millions of dollars to the market for air conditioning equipment, it is estimated by the Refrigeration Equipment Manufacturers Association following an analysis of the 1947 and 1948 construction programs of radio and television broadcasters and a review of the air conditioning requirements in both studios and audience auditoriums.

A technical "must" in television stations and an important adjunct to all types of radio broadcasting, air conditioning is used in the majority of the estimated 1062 standard AM radio, 136 FM radio and seven commercial television stations now on the air. In all of these stations, air conditioning plays a double and—in the case of television—a triple role. In radio broadcasting, particularly in the quality of transmission that is important in new frequency modulation, soundproofing of the studios and filtering of the air go hand in hand with providing coolness and comfort to the radio performers. In audience auditoriums, air conditioning has a usefulness which parallels its utility in legitimate and motion picture theaters.

It is in television, however, that air conditioning is most essential to successful broadcasting, and refrigeration industry leaders, looking ahead to the time when several hundred television stations will be in operation, predict that television will require volume production of the type of air conditioning equipment successfully employed in motion picture studios.

"The concentrated heat of batteries of powerful lamps used in television stations is what makes studio air conditioning so necessary," an industry spokesman said. "The trend is toward studio audiences in television stations, which means that between 20 and 25 performers and technicians and around 100 spectators are grouped in a soundproofed studio and subjected to the radiant heat of the lights."



Radiant Panel Heating System Solves Textile Plant Problems

G. Lorne Wiggs, Consulting Engineer, Says Installation at Verney Mills Avoids Usual Difficulties Due to Airborne Lint, Excessive Humidities

HEATING AT THE Verney Mills of Canada, Granby, Quebec, is an original application of the radiant panel method used to solve certain process problems peculiar to the textile industry. This industry presents the ever-present problem of airborne lint, which is often the cause of high maintenance costs due to frequent cleaning of heating equipment. Of considerable importance also is the excessive humidity encountered in certain processing departments. It can be conservatively stated that after one heating season the Verney installation seems to offer a very ready solution to these problems.

Verney Mills now consists of two plant sections: the original office and mill and the new addition, which is of completely modern functional design. The new addition consists of two stories in the fore part with a single story dye house in the rear. The section comprising the dye house and boiler room is known as the east block, while the two story section containing picking, carding, drawing, spinning, and warping departments is called the west block.

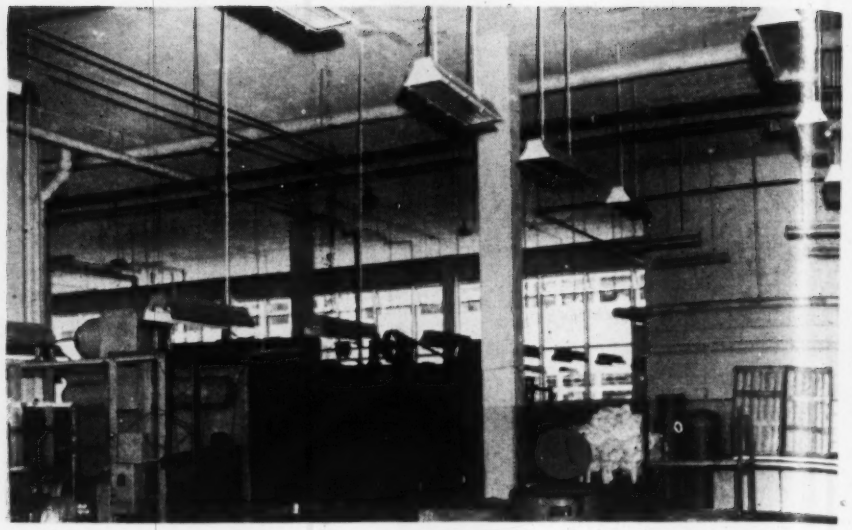
Steam is generated in coal fired horizontal return tubular boilers and piped to two heat exchangers that provide warm water for the panel system. The water is forced through the various circuits by centrifugal pumps, one electrically driven and the other by steam turbine. Water leaving the exchangers is fed into a main header from which it flows to two 3-way mixing valves, thermostatically controlled. One of these valves (3 in. size) controls water temperature to the east block, and the other, a 4 in. valve, modulates the water temperature to the west block.

AN ORIGINAL application of the radiant panel heating method to solve certain problems peculiar to the textile industry is described here by the consulting engineer who designed and supervised the installation. Textile plants present the ever-present problem of airborne lint, which is often the cause of high maintenance costs due to frequent cleaning of heating equipment. Of considerable importance also is the excessive humidity encountered in certain processing departments. Layout of the system and results are discussed.

East Block Heated by Ceiling Panel

On leaving the 3 in. automatic valve, water travels to the east block through two $2\frac{1}{2}$ in. supply mains, each of which traverses the perimeter of the roof slab. This block is heated by a ceiling panel in the roof slab, the panel consisting of 1 in. pipe placed on centers varying to suit the expected heat loss of each section.

The roof was divided into a number of sections, each one of which can be manually controlled. For example, an L shaped section is heat-



Corner of dye house showing open skein dye vats on right, and skein dryer in center. The radiant heating coils are in the 20 ft concrete ceiling

ed by 1 in. pipe on 12 and 15 in. centers. This section is the electricians' shop and consists of two stories, the second housing the motor repair section and office, and the first or ground floor housing the machine shop. The second floor or mezzanine is heated by coils in the roof; the machine shop is heated by a second coil, consisting of 1 in. pipe on 15 in. centers, in the ground floor ceiling slab.

Returns from the dye house, mezzanine and machine shop, $2\frac{1}{2}$ and $1\frac{1}{2}$ in., respectively, are tied into the main 5 in. return at the boiler room.

All roof panels are backed by 2 in. of rigid insulation above and a tar and gravel flat roof. Viewed from below, there is no evidence of the existence of piping in the slab as it is completely embedded in the concrete.

West Block Has Floor and Ceiling Panels

The two story west block is heated by a floor panel for the major portion of the ground floor and a ceiling panel on the second floor. The office areas, the jacquard card room, and the receiving room on the ground floor are heated by ceiling panels. The discharge of the 4 in. mixing valve in the boiler room is split into a 3 in. main to the ground floor of the west block, a 2 in. main to the second floor panel, and a $3\frac{1}{2}$ in. main to the roof panel. Returns from all panels are tied into a 5 in. main, routed beneath the floor adjacent to the outside wall of the ground floor.

The ground floor coil was laid directly on crushed stone fill and covered with concrete. It consists of two main sections, each handling one-half of the building heat loss and each covering approximately 50 per cent of the floor. One inch pipe in a combination grid-sinous coil, spaced 25 in. center to center, is used and $1\frac{1}{2}$ in. headers in combination with 2 in. mains complete the circuits. Each section is valved and vented at one point so that the heat release of each coil can be manually controlled for balancing.

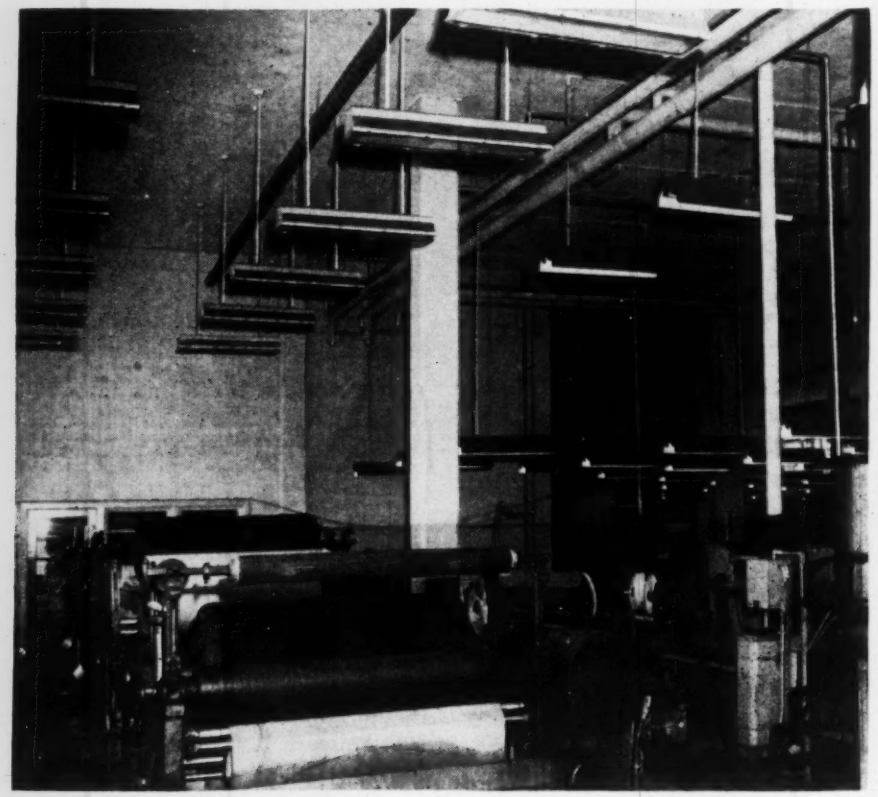
The jacquard card room and the receiving room are also on this floor, and a single run of $1\frac{1}{4}$ in. pipe runs around their peripheries to offset part of the heat loss, which is fully compensated for by a ceiling coil. Offices off the main working area have floor panels of $1\frac{1}{4}$ in. pipe in sinuous coils, spaced at 12 and 10 in. centers. The coils in the jacquard card room and receiving room and those in the offices are all valved and vented.

The ceiling panels for the jacquard card room and receiving section consist of combination grid and sinuous coils terminating in $1\frac{1}{2}$ in. headers. The jacquard card room is heated by 1 in. pipe, 15 in. center to center, while the receiving section, because of the high rate of infiltration, required 1 in. pipe at 14 in. centers.

Ceiling panels in the small offices consist of 1 in. pipe at 10 in. centers and $1\frac{1}{4}$ in. pipe at 12 in. centers.

All ceiling coils are valved and vented to permit maximum flexibility in operation.

The entire second floor is heated by ceiling panels, the heat for which is derived from 1 in. pipe on various



Corner of dye house showing dye jigs and vaporproof fluorescent lights over them. The radiant heating coils are in the ceiling, which is 20 ft high

G. LORNE WIGGS, consulting engineer, author of this article, is fast gaining repute as an eastern Canadian authority on radiant panel heating due to some 17 years of successful application of his designs to buildings in the Montreal area. His first installation was made in 1929 and others were made until 1939, when war activity took him into governmental service as a consultant on aircraft manufacturing plant construction. . . . Immediately upon completion of his war service, Mr. Wiggs designed and supervised the Verney Mills installation. Other installations completed since the war include a portion of another textile mill and an addition to a large oil refinery. Installations now under construction or designed include a half dozen large residential jobs, a large church, and a 12-story office building with 70,000 sq ft of floor space. Portions of the office building and some of the residences are so designed that with the installation of suitable refrigeration, the heating panels can also be used for cooling in summer.

centers. The main area is served by two coils, combination grid and sinuous, made up of 1 in. pipe runs at 10 in. centers and $1\frac{1}{2}$ and $2\frac{1}{2}$ in. headers, the larger headers being used to furnish additional heat to the most exposed walls.

The office and stairwell are heated by 1 in. pipe at 10 and 12 in centers, the pipe being formed into sinuous coils.

A working area at one side, separated from the main section by a partition, is heated by 1 in. pipe on 15 in. centers and arranged as a large grid, with a $1\frac{1}{2}$ in. header at each end. An adjacent office area is heated by 1 in. pipe at 18 and 11 in. centers arranged as sinuous coils. An office with two walls exposed uses a convector as a booster in very severe weather.

All ceiling coils on this second floor are valved and vented separately, so that control of any area is available.

Pressure Welding Machine Used

Wrought iron pipe was utilized for all coils and mains of the heating system, the pipe being bent and fabricated in coils on the site with all joints being welded. As far as possible, all welds were made by oxyacetylene pressure welding using a pressure welding machine. This machine enabled its operator to produce welds of such excellence and uniformity, with such speed, and at a relatively lower unit cost than other forms of field welding that some details of its construction and operation would undoubtedly be of interest.

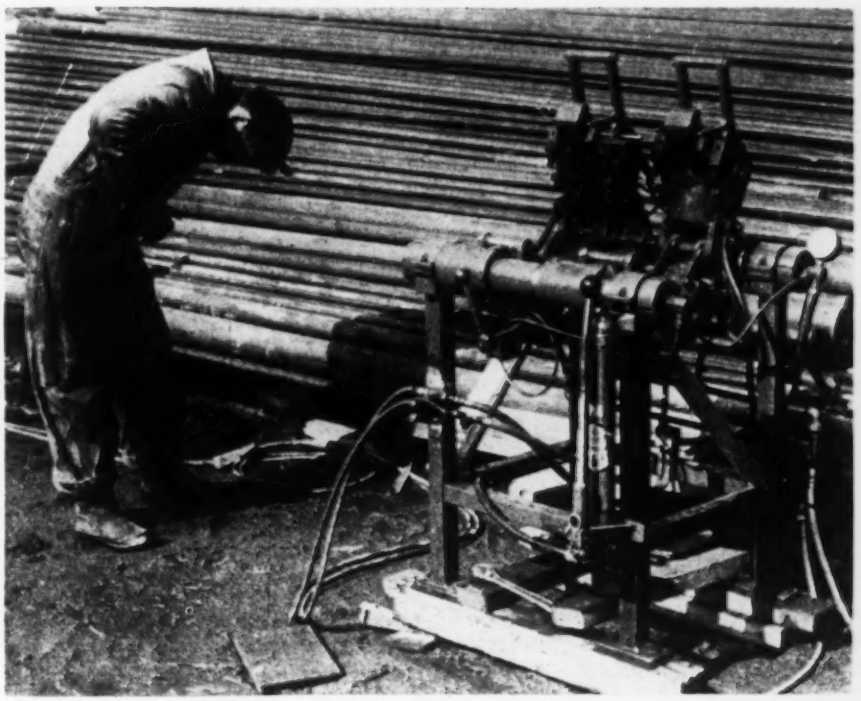
The pressure welding machine consists of a substantial stand having a fixed and a movable pipe clamp mounted on it, with an oxyacetylene ring type heating head located between the two clamps. Both the clamps and the heating head are water cooled. The movable clamp is actuated by a manually operated hydraulic pump attached to one leg of the machine so that the required welding pressure can readily be applied through the clamps to the pipe being butt welded.

The pressure welding procedure is as follows: The upper halves of the clamps and of the heating head are opened. The ends of the pipe to be welded are cleaned of rust or scale. The two pieces of pipe are then placed in the lower clamps, butting together midway between the fixed and moving clamps. The upper halves of the clamps and of the heating head are closed and the heating head is centered over the joint by means of a handle at the center of the front of the machine.

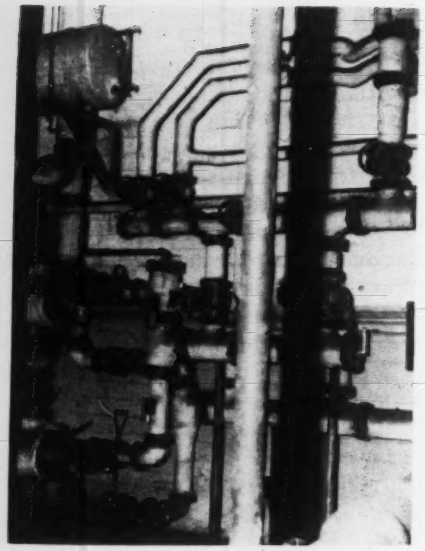
An initial pressure of about 600 psi is then applied, which is indicated on a pressure gage on the machine. With the acetylene and oxygen valves adjusted to their required pressures, the gas is turned on by means of a quick acting valve and the heating head flame is ignited. The pressure in the hydraulic oil system will increase as heating progresses due to the expansion of the pipe until a maximum is reached and then it falls off, indicating that upsetting is taking place. The prescribed welding pressure is then applied by the hydraulic pump until the recommended amount of shortening is obtained, when pumping is discontinued and the heat is shut off. The pressure in the hydraulic system is then released by opening a valve at the base of the pump, the clamps are opened, and the welded joint is removed from the machine.

The entire operation can be performed in less than a minute and the resulting weld is uniform around the circumference of the pipe, with very slight upsetting on the inside and all possibility of forming nuggets or icicles eliminated. The machine used will weld up to and including 3 in. pipe and is rated at a capacity of 8 tons. It may be used for the pressure welding of round, square and hexagonal solid bar stock, reinforcing rods, and many other shapes.

It is probable that if pressure welding is to be widely used for radiant heating installations that a smaller and a less costly machine should be made. It might be designed for welding standard pipe up to and including $1\frac{1}{2}$ in. and have a rated capacity of 1 ton or less. Such a machine should be somewhat less costly and should be considerably more portable than



As far as possible, all welds were made by oxyacetylene pressure welding, using this rather large machine.



View showing two electrically operated mixing valves on right and the ends of the two steam converters on left with the end of the expansion tank, with gage glass, above the converters. The converters and control valves are so valved that normally one converter and one control valve serve each of the two zones but in the event of failure of either converter the remaining converter may be connected to both zones or in the event of failure of either control, both zones may be thrown onto the other

From the foregoing description it may be correctly inferred that—while a good deal of careful design was required—the overall system is quite straightforward and required a minimum of expenditure for its installation. From a first cost standpoint, the design is also interesting as the installed cost is believed to be less than that for a conventional steam system.

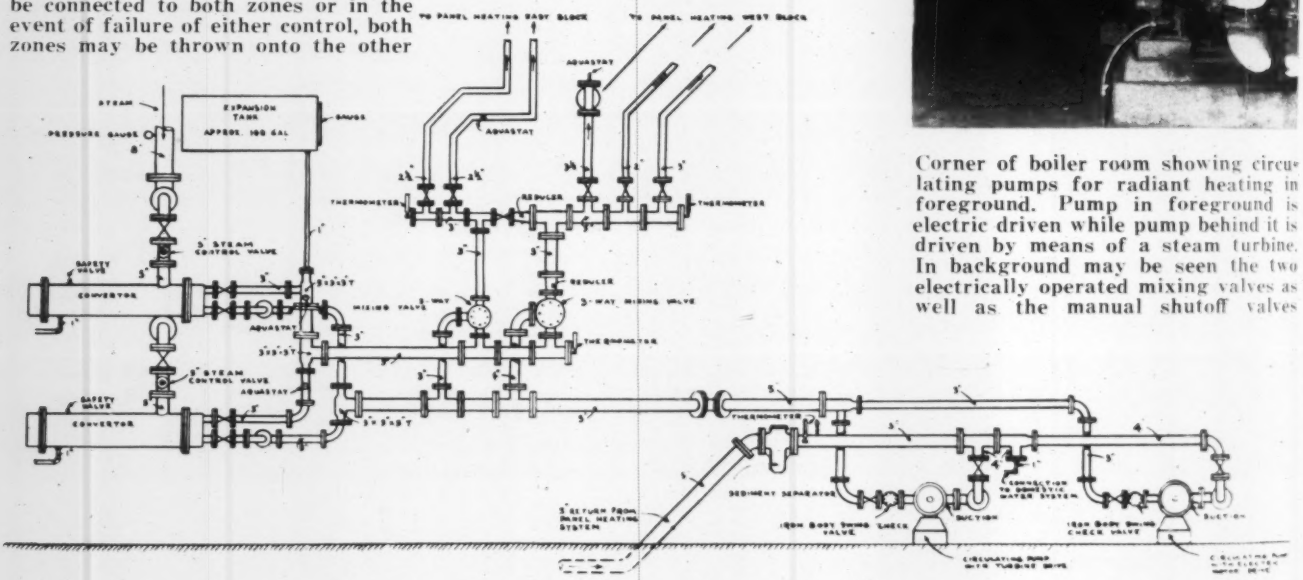
In operation, the system has been a marked success, as all lint accumulates on the floors from where it is easily removed. Comfort of a high degree is a feature.

Observations made on a 29 F day disclosed the following:

Temperature of leaving water, 108 F.

Warp room—radiant floor heating:
- Breathing line temperature, 75 F dry.
- Relative humidity, 67½ per cent.
- Floor temperature, 80-83 F.

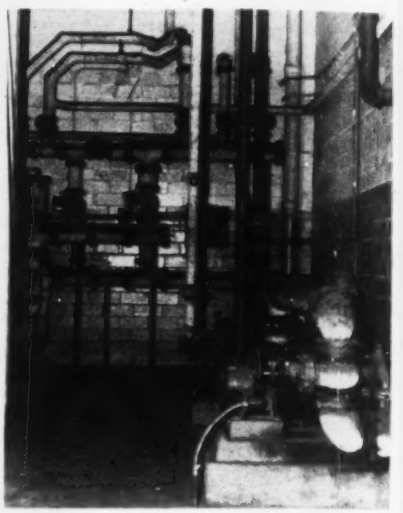
Weave room—unit heaters:
- Breathing line temperature, 75 F dry.
- Relative humidity, 67½ per cent.
- Floor temperature, 69 F.



Arrangement of piping for control of panel heating system

In the dye house, no fog was evident, except for those areas over dye vats and can dryers, where steam formation occurred for a height of about 4 ft; above this elevation, the steam vanished. The top ventilating openings in most of the windows were raised but no fog was evident. The ceiling was completely dry at all points.

To those familiar with dye house conditions, the foregoing will seem



Corner of boiler room showing circulating pumps for radiant heating in foreground. Pump in foreground is electric driven while pump behind it is driven by means of a steam turbine. In background may be seen the two electrically operated mixing valves as well as the manual shutoff valves

the machine used on this installation, particularly if it could be designed to eliminate the necessity for water cooling.

The bends in the pipe coils were made on the job by means of electricians' hickeys.

The entire radiant heating installation was made by a crew which at times consisted of two mechanics and two helpers but which was made up of one mechanic and one helper most of the time.

In the dye house, with radiant ceiling heating, no air handling equipment, the following condition obtained:

Breathing line temperature, 78 F dry.
Relative humidity, 47 per cent.
Floor temperature, 80 F.

(Note that this section is heated with a ceiling panel, 20 ft 0 in. from the floor. The floor is concrete on the ground. The floor temperature was 11 F higher than that in the weave room although the difference in air temperatures was only F.)

almost unbelievable, and the unusual temperature of the slab floor seems to prove the efficiency of ceiling radiant panels in spite of higher-than-average ceiling heights.

The management states that the conditions produced have resulted in increased efficiency and morale.

[The architect for this project was H. Ross Wiggs, and the consulting engineer was G. Lorne Wiggs & Co. Richard & B. A. Ryan, Ltd., was the general contractor, and Thomas O'Connoll Ltd. was the heating contractor.]

Gives Dope on Airport Snow Removal with Heat at Road Builders' Meeting

George B. Coffey Answers Questions at Convention "Town Hall" Session

A "TOWN hall meeting" on airports was a feature of the annual convention of the American Road Builders' Association held in Chicago last month, with George B. Coffey, Chicago regional manager of A. M. Byers Co., serving as the "expert on radiant heat for airport snow removal."

In reply to the question, To what types of roadway construction has snow melting by means of embedded heating pipes been applied, and what results have been obtained? he said:

"Unfortunately, we have no airport runways in this country with snow melting installed. We understand that our boys found such runways in Germany after we occupied that country. Again, unfortunately, we have not been able to secure any details from there. There is one designed, but not built yet, for an army airport.

"We do have some rather long roadways, such as an 1100 ft private roadway in Massachusetts, and a 600 ft long, 24 ft wide industrial plant roadway. These and all the smaller systems we know about are operating very satisfactorily.

"In one industrial job at Buffalo, a driveway was kept clear during a 68 in. snowfall that lasted for three days last winter. That is the most extreme test we know of for any snow melting system."

Answering the question, Are the installation and operating costs of snow melting by this method prohibitive or are economies involved? Mr. Coffey replied:

"The cost of installing a snow melting system is not exorbitant if it can be installed as the runway slab is being laid. On one engineer's estimate for a large airport, it was less than the cost of snow removal equipment. You gentlemen know better than I do how much equipment is needed to clear a runway. With such a system, the snow is not just pushed to one side or piled up, forming landing hazards; also bear in mind that ice is removed as well as snow.

"The operating cost reports that we have are also much cheaper than manpower costs of shoveling. One ton of 10,000 Btu coal will remove 1 in. of snow from 200,000 sq ft of runway. In other words, the NW-SE runway at the municipal airport in Chicago could be cleared of 1 in. of snow with 6.5 tons of this type of coal (175 ft x 7300 ft). A smaller scale example is a private driveway in Pittsburgh, 110 ft long, which was melted and evaporated of 15 in. of snow in 2 hr at a total cost of 60c for gas. The same winter, this owner melted ½ in. of ice in 20 min."

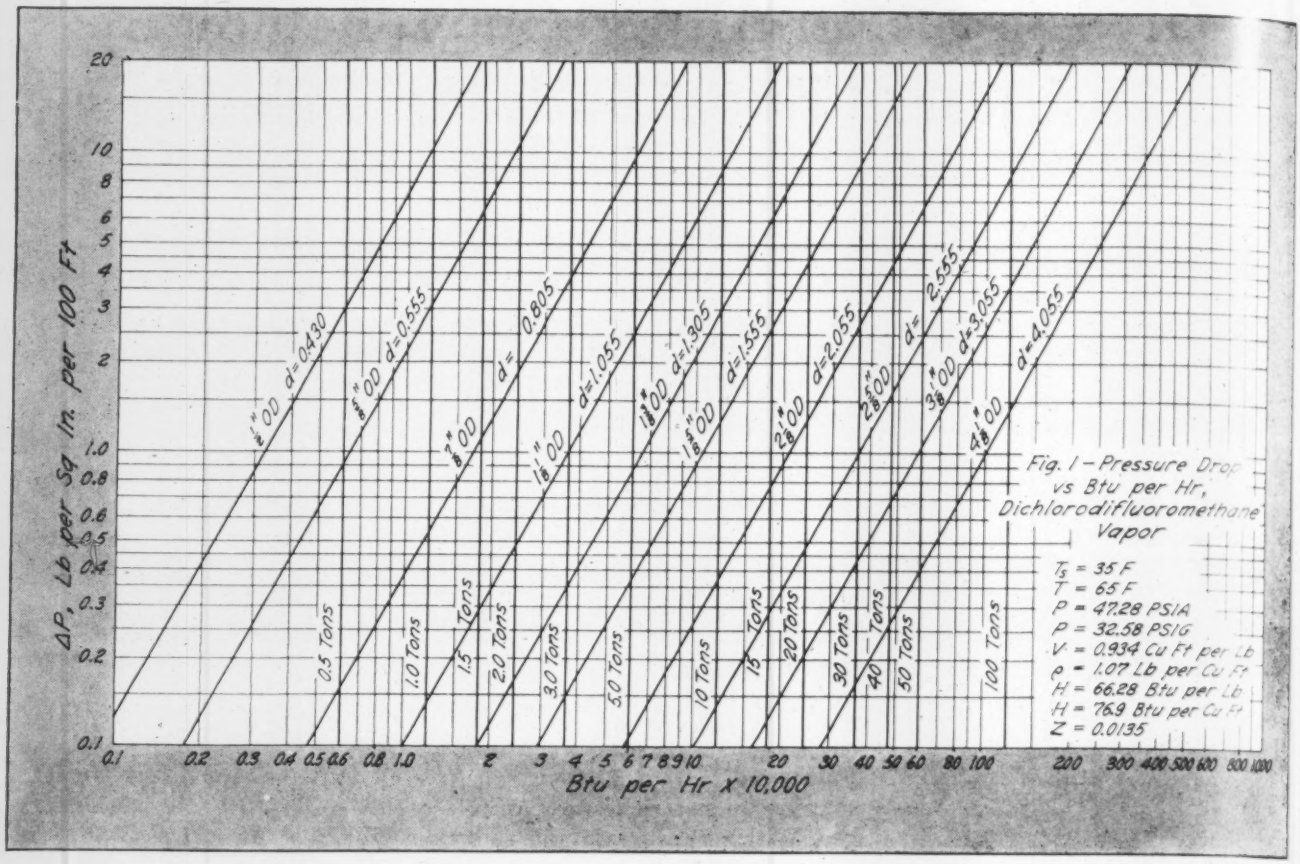
When asked, What principles of design have been followed by designers of existing installations? Mr. Coffey stated:

"Design principles are fairly simple. In the first place, it is imperative, we feel, that hot water be used in the coils, this medium being entirely practical when permanent type antifreeze solutions are employed. Systems are only heated when needed. On small jobs, water can be circulated direct from the boiler. On large jobs, such as the runways of an airport, steam can be generated and heat exchangers placed at intervals along the runway. These converters can be placed below grade so as to avoid any obstruction to plane landings.

"The expansion and contraction problems in the construction of the runway are not affected by the system, since their design is based on the extremes of summer sun and the cold winter. The heat of the slab temperature will never reach that produced by the sun in July.

"The rest of the design is merely selecting a size pipe and a water temperature that will melt the snow in the desired time. It is then an easy matter to design a coil that will fit."

This photo of the two-lane, 600 ft long "snow melting" driveway installed by the American Cyanamid Co., Bridgeville, Pa., was taken shortly after a snowfall to illustrate how the snow melting system operated. Since two runs of wrought iron pipe were embedded in the driveway pavement under each wheel track, the snow was melted in those areas first. The snow in the center also was melted as heat gradually spread throughout the slab, but the most important objective — to quickly clear wheel track areas—was accomplished by the system. Water for the system is supplied from a small heat exchanger connected to the steam boiler. On this first operation, 140 F water was used. Subsequent operation will be with 165 F water, which will make the system even more effective than now.



Fluid Flow's Relation to Installation & Operation

H. E. FERRILL EXPLAINS HOW SUCTION LINE SIZE AFFECTS REFRIGERATION AND AIR CONDITIONING

TO A LARGE number of installation and layout engineers, the study of the flow of fluids through pipes or other conductors is a science which may very well be left to laboratory technicians and classroom discussions. Comparatively little application information has been—and is even now—presented in a form readily usable by or even convenient for the engineer. The chief result of this lack of proper information has been neglect, in a great many cases, of certain engineering fundamentals. Consequently, in these cases, otherwise good equipment has been penalized by faulty installation — with resultant customer dissatisfaction and poor economy to both the customer and the contractor.

An error in the size of refrigerant piping is not immediately apparent, being extremely difficult to determine on the average installation. There is no convenient adjustment to correct or compensate, and the error can impose severe penalties on the capacity of the condensing unit—sometimes as much as 30 per cent.

Considerable time is spent in the layout of any sizable installation. It is necessary to estimate carefully the load with due regard to the sensible and latent heat proportions, and to select just as carefully the major pieces of equipment to arrive at a properly balanced system. The best equipment available today performs correctly only when applied as intended by its designers and manufacturers. Few engineers would intentionally undersize a condensing unit or a coil by 25 or 30 per cent. This is particularly true if he is a service contractor, since an overworked system requires excessive maintenance. Yet it is possible to do just that (or to accomplish the same result) if proper

NEGLECT OF ENGINEERING fundamentals may penalize otherwise good equipment with a faulty installation, causing headaches for all concerned. Mr. Ferrill, who is chief engineer of the brass division of the Kerotest Mfg. Co., discusses here the importance of fluid flow in refrigerant suction piping and its relation to installation and operation problems. A second article will analyze a typical installation, illustrating the relation between pressure drop, as determined through an understanding of fluid flow, and operating characteristics.

attention is not given to the correct sizing of the refrigerant piping. Accordingly, the engineer should be reasonably well acquainted with the factors affecting the flow of the refrigerant through its piping in order to make the necessary allowances and to select the proper sizes for the particular application.

Exponential Equations of Small Value

The study of fluids—either liquids or gases—in motion is admittedly rather complex. It is of small value to the practising engineer to encumber himself with exponential equations and complicated formulas and diagrams. It is of considerable importance, however, that he be familiar with how these moving liquids and gases affect the operation of the system he has designed; often it makes the difference between the installation he wanted and one he has to live with. A reasonably thorough, logical understanding of these factors and their influence requires comparatively little time and can be of great benefit if properly utilized.

Pressure Drop in Suction Line Important

The movement of any fluid through a pipe requires that a difference of pressure exist between the two ends of the pipe. Obviously, if this difference of pressure did not exist, the fluid in the pipe would be stationary and not in motion. It is this pressure differential with which the engineer is vitally concerned, the success or failure of a great many of his installations depending on its proper evaluation and prediction. In air conditioning and refrigeration work it is referred to as "pressure drop" and is a measurable difference in pressure between the two ends of a section of piping. Of most importance is the pressure drop in the suction line, since that has the most direct bearing on the capacity of the condensing unit. Obviously, the greater the difference in pressure, the greater the velocity of the fluid but this relation is not direct and velocity is not the only influencing factor. The actual pressure drop for any given set of conditions may be determined through the use of rather complex formulas, most of which are empirical. A graphic solution of these formulas is represented in Fig. 1 and will be discussed later.

Fundamentally, fluid flow formulas are divided into two sets of conditions within which the various factors bear entirely different relations to the final result. These two conditions are known as "streamline" flow and "turbulent" flow. Distinction between the two conditions is determined by the value of the so-called "Reynolds number" (named for an early investigator of the subject). This number is directly proportional to the diameter of the tube, the velocity, and the density of the refrigerant, and inversely proportional to its viscosity. Conditions encountered in refrigerant suction piping invariably establish the flow as turbulent in nature. From this Reynolds number, and knowing the size and surface characteristics of the piping, a "friction factor" may be obtained. The pressure differential may be expressed then as directly proportional to the friction factor, the density of the refrigerant, and to the square of its velocity, and inversely proportional to the diameter of the pipe.

It is obvious, of course, that an application engineer would be inclined to guess or estimate rather than spend the time required for such long and involved computations. Proper selection would require the trial and error method, going through the entire problem two or three times before arriving at the right answer. In order to eliminate this unnecessary repetition and to save valuable time, various charts or diagrams have been prepared which represent a graphic solution of the problem. Fig. 1 is a diagram of this type and may be used to determine the pressure drop expressed in pounds per square inch (psi) per 100 ft of suction line length for any combination of Btu load and tubing size.

Basis of Fig. 1

In view of the characteristics of the refrigerant upon which pressure drop depends (as stated above) it is necessary that any such chart be computed for a given set of conditions. Those chosen for Fig. 1 are "Freon 12" refrigerant; a saturation temperature of 35 F; an actual temperature of 65 F; a pressure of 32.58 psig* (corresponding to a saturation temperature of 35 F). These conditions are typical of those encountered in the average air conditioning suction line. Formulas and other data were obtained from the American Society of Refrigerating Engineers' Data Book. Z on the chart refers to viscosity of the vapor in centipoises.

Inspection of the chart shows $\triangle P$ (pressure drop) expressed in

*"Psig" means pounds per square inch gage, and "psia" means pounds per square inch absolute.

lb per sq in. per 100 ft, from a value of 0.1 to a value of 20.0 as a vertical coordinate. The horizontal coordinate represents Btu's per hr load from 1000 to 10,000,000. This scale is also calibrated in tons refrigerating effect from 0.5 to 100. Suction line sizes are shown as diagonal lines, the chart covering standard weight copper tubing from ⅛ in. to 4⅛ in OD. Respective actual inside diameters are also given and may be used as a guide in interpolating for standard pipe sizes. Velocity lines, if plotted, would be approximately perpendicular to the tubing size lines, the higher velocities lying in the upper right hand region of the chart.

Using the Chart

The chart is normally entered with a known hourly Btu load and some idea of what total pressure drop may be allowed. The Btu load is, of course, obtained from an estimate at the time of layout or from the manufacturer's coil rating. The total allowable pressure drop requires the consideration of various factors, some of which can be rather accurately determined while others must be estimated.

The first, and usually the most important, is the question of how low the suction pressure at the compressor inlet can be and still retain sufficient capacity for the job according to the manufacturer's rating. Suction pressure has a most decided effect on condensing unit capacity, the lower the pressure the lower the capacity. Accordingly, if the evaporator load is near the condensing unit capacity, it must be remembered that the evaporator and the condensing unit must be selected, and will operate, at different pressures; these pressures will differ by the amount of pressure drop encountered in the suction line.

For example, if an evaporator has a capacity of 120,000 Btu per hr at a temperature corresponding to 32.5 psig and a condensing unit a capacity of 120,000 Btu per hr at a suction pressure of 30.0 psig, a suction line between the two should not impose a total pressure differential, including that due to the heat exchanger, of more than 2.5 psig. If this differential is more than 2.5 psig and the evaporator pressure is 32.5 psig, the suction pressure at the compressor will be lower and the capacity of the condensing unit correspondingly decreased.

Also of great importance in determining the total pressure drop is an evaluation of the equivalent length of suction line. If the line were straight between the evaporator outlet and the compressor inlet, this would be equal to the linear length of the piping. Since this is never the case, the line containing valves, fittings, heat exchangers, etc., allowance must be made for the additional resistance encountered. Most heat exchangers available are rated by their manufacturers. However up to the present time, very little data have been published regarding the resistance imposed by valves, manifolds, elbows, tees, etc. In the absence of this published information it is well to consider this additional resistance as from 50 to 100 per cent of the resistance due to the straight run of tubing. Accordingly, the equivalent length of suction line will then be from 1.5 to 2.0 times the actual linear length. The figure thus obtained should be used in determining the actual total pressure drop after ΔP is determined by means of the chart. To this must be added that resistance imposed by heat exchangers and other accessories which are accurately rated.

Proper Velocity to Carry Oil

The effect of both of these factors is to increase the size of the suction piping, keeping the velocity and pressure drop at a minimum in order to gain capacity. Selection on the basis of these two factors alone would result in a low velocity which, in some instances, would be insufficient to insure the proper circulation of oil. For "Freon" vapor to carry the percentage of oil normally circulated, experience has shown that it must have a velocity in the neighborhood of 1200 to 1400 fpm. In small sizes of tubing this velocity corresponds to a pressure drop of approximately 2.0 psi per 100 ft. This pressure drop is lower for the same velocity in larger sizes of tubing. However, the value of $\Delta P = 2.0$ psi per 100 ft is an excellent value to use as a guide in selecting suction line sizes. It insures proper oil circulation at all times and almost never results in exceptionally high differentials.

It is admitted that there are a great many installations where—from a purely capacity standpoint—particular attention need not be given to selecting accurately a suction line size, commonsense being sufficient. These cases are invariably those wherein the condensing unit has a capacity considerably in excess of that of the evaporator. However, from an operation standpoint, especially when close control of humidity is desired, the characteristics of each installation should be closely analyzed. Much valuable information may be obtained that will be of immeasurable assistance in making initial adjustments and in solving future servicing and operating problems. An analysis of a typical installation illustrating the relation between suction line pressure drop, as determined through an understanding of the nature of fluid flow, and operating characteristics, will be given in a second article.

NEW MAGAZINE ON FEDERAL SCIENCE APPEARS

Federal Science Progress is a new monthly magazine covering the field of government sponsored scientific and technological research and edited for business men rather than technically trained readers. It is published by the Office of Technical Services, Department of Commerce, the first issue being dated February 1947.

A roundup of wartime developments in the field of "tropicalization" describes the various measures manufacturers and exporters must use to protect their products from the effects of heat and humidity. Other subjects include solar heating, weather and industry, and many others.

Single copies of the magazine and annual subscriptions are available through the Superintendent of Documents, Washington 25, D. C. The subscription price is $3 a year, single copies 25c ($4 and 30c abroad).

ALUMINUM . . . . for ducts

Informal Report on Current Practice

SHORT SUPPLIES (perhaps "nonexistent" would be a better word than "short") of galvanized sheets for air conditioning and ventilating ducts in plants and large buildings have resulted in increasing use of aluminum for such work. Some ventilating and air conditioning contractors definitely regard aluminum at this time as a "substitute" for galvanized, but whether or not it will continue to be regarded in this light will depend primarily upon the price (and the availability) of the two materials in the future, experience of sheet metal men in the fabrication and erection of aluminum ducts, and the performance of the aluminum ducts in actual service—both resistance to corrosion and ability to withstand mechanical damage. In connection with the latter point, some contractors and engineers seem to feel that an aluminum duct is more susceptible to damage from the other trades—while others believe it is no more likely to be damaged by, say, steamfitters working on an adjacent pipe line than is a galvanized duct run.

In residential work and on some commercial installations, aluminum is considered to have an advantage from the appearance standpoint when the ducts are left exposed. The light weight of aluminum is also a handling feature.

The foreman for a large ventilating contractor, interviewed last month on a job where aluminum ducts are being used for air conditioning an additional floor in a department store, thought the material "fine to work with." He was finding no problems whatever in this first experience of his with aluminum, and was very pleased with the ease of handling and the appearance of the finished work. No differences were necessary in fabrication or erection compared with galvanized, in his opinion, the aluminum sheets being approximately equivalent to 20 gage. He thought that aluminum was excellent for ceiling runs, but would hesitate to use it for risers where it might be exposed to bumps or knocks after installation.

The hangers for these ducts are of black iron, with bolts rather than sheet metal screws being used. It was thought there might be a possibility with black iron hangers and aluminum ducts that electrolytic action over a period of years would enlarge the holes around the screws slightly. By using bolts, any slight electrolytic action of this kind could cause no trouble.

Alloys and Hardnesses Used

The head of another large air conditioning and ventilating contracting firm has used a large amount of aluminum sheets on recent jobs—as a substitute, he is frank to say, for galvanized. It is his opinion that the 2S and 3S alloys in the half-hard (½ H) temper are the proper aluminum sheets to use for ducts; others, however, have found 2S, ¾ H entirely satisfactory. His company has aluminum sheets available in the 0.025, 0.032, and 0.040 in. thicknesses, and uses these thicknesses as equivalent to 24, 22, and 20 gage galvanized respectively.

Neither this contractor nor the one previously mentioned has had any difficulties whatever in the various shop fabrication procedures with aluminum and they handle aluminum exactly as they do galvanized. The second firm, however, has had trouble with aluminum when it is necessary to force a connection in erecting the duct work. Oil, soap, lard and other materials have been used to prevent the aluminum surfaces from sticking, but it has been their experience that there are some connections that just have to be slammed and that the aluminum can't take it as well as can galvanized. What this contractor would like to do is get enough 26 gage galvanized so that he could afford to use it for cleats on the aluminum installations.

Aluminum hangers are being used on this contractor's aluminum duct jobs, with bolts rather than sheet metal screws.

One contractor interviewed is quoting 10 per cent higher for aluminum duct work per pound over galvanized to cover his increased costs—if any. The future cost differential depends, of course, upon the material costs for the two metals and contractor experience with the newer one. Because aluminum has one-third the weight of galvanized, 24c per lb aluminum is equivalent to 8c galvanized material cost. Those who currently regard aluminum as a "substitute material" for duct construction seem not only willing to change their views if experience during the coming months so warrants but also appear quite thankful to use it now after their wartime experiences with some substitute materials for large sheet metal ducts.

Design Engineer Reports on Operating Experience

John H. Clarke, Marine Engineer,
Writes of Pumping, Piping Troubles

HAVING SURVIVED the first episode of my seagoing "safari" at the cost of about 10 lb of weight and a lot of lost sleep, I took a rest cure for 10 days before accepting an assignment on another vessel, a 6600 hp turbo-electric tanker that had recently returned from a long trip. There was a considerable amount of repair work to be done.

Cleaning and rebalancing of the rotor of the inboard turbo-generator was an important item. The blading of the turbine had been so heavily coated with rust that it was out of balance and the unit could no longer be operated. It was understood that this was caused by the fact that the gland leakoffs were run to an atmospheric drain tank with no shutoff valves provided to prevent vapor from coming back up the line and condensing in the turbine casing. To make matters worse, the "belly" or casing drains for the units were connected to the gland leakoff drains. If memory serves me, the previous crew had disconnected the sealing water lines to the glands of the generator-turbine exhaust valves.

Under the direction of the turbine manufacturer's representative, the casing drains of the turbines were disconnected and run to the bilge, as they should have been originally. The sealing water lines were reconnected to the exhaust valves and the rotor of the inboard turbine was removed, cleaned, and rebalanced. In the process it was discovered that the turbine was a few thousandths of an inch low at the forward end, and this was corrected. This resulted in a considerable amount of noise at first in the reduction gears with which these units were furnished, but the unit gradually quieted down over the period of the trip as the gears wore in to the new position.

The turbine rotor, so I understood, was cleaned by the newly developed blasting method* whereby a soft material such as corn or grain hulls is used as the blast ingredient. If this is true, a very fine job of cleaning was done.

As indicated by the subsequent trip, it was probably not vapor coming up from the drain tank that caused the rusting, although valves should have been provided in the gland leakoff lines. Actually, the water was coming from the sealing water lines to the exhaust valve glands, the casing of the shutdown turbine being filled with water therefrom. Subsequent experience indicated clearly that the exhaust valve glands were not properly packed to contain the sealing water, and were consequently passing water in the amount of about 8000 gal. per day into the turbine casings at any time the sealing water was turned on. It is believed that this is the real reason that the previous crew disconnected the lines.

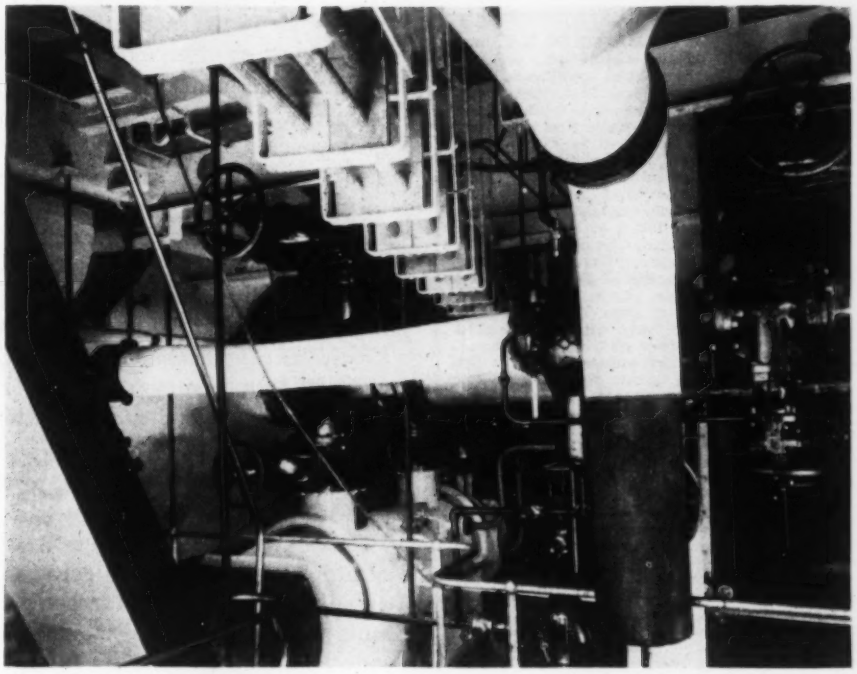
The forward feed pump impeller was removed and the casing was welded up in several spots where interstage cutting or erosion had taken place. Several of the cutwaters on the impeller (it was a six stage pump) had eroded considerably and these were also welded up, although it was a question as to whether they were better before or after because the weld metal was not machined or filed to a smooth contour.

As another item, it was necessary to renew all of the bearings on both the turbine driver and on the pump. Lastly, the cooling water connection to the thrust end bearing housing of both of the main feed pumps was changed so as to provide crossflow in the water jacket by connecting the supply and return on opposite sides, instead of the same side.

It was in making this change that an incident took place which, although of minor importance, is nevertheless typical of the attitude or lack of pride in workmanship of too many present day craftsmen. The machinists and pipefitters involved had removed the oil gage glass for the bearing housing in order to make it easier to work on the cooling water piping. But they went awry on their sequence, and when they had the water pipe all connected up, they could no longer

*See Soft Grit Blasting of Metals, by E. C. Lothrop and S. I. Aronovsky, Compressed Air Magazine, October 1945, for information on this method.

DIRECT, FIRST-HAND experience on how designs perform in service, how the equipment is actually operated, and what troubles are encountered were Mr. Clarke's objectives when he (a design engineer by training and profession) shipped on a tanker as junior third assistant engineer. The experience he got was most illuminating, and he reports on some of the piping and pumping difficulties here, continuing his tale from our previous issue . . . His comments and observations are of interest not only in connection with marine work, for many of them apply to mechanical equipment in plants and buildings as well . . . His seagoing phase completed, the author is now a design engineer with the Standard Oil Co. of Indiana



View of lower machinery space looking aft. The two valves above to the left and to the right are the auxiliary turbo-generator exhaust valves. It was the sealing water to these valve glands that flooded the inboard turbine casing, rusting the rotor and blades. Auxiliary condenser on the left

screw in the gage glass because of the interference. So they put the gage glass on the outboard (back) side of the housing where it was very difficult to see and to check. Despite the fact that they had made an error in doing so, they insisted that there was no reason why the gage shouldn't be all right on the back side and that a person could easily lean around the pump to look at it. They threatened to quit rather than change it.

One doesn't have to be an operating engineer to realize the absurdity of such a thing. All gages, thermometers, and other important instruments should be as accessible as possible so that trouble will be noticed immediately. Instruments that are hidden away lose much of their value. And yet many times this same sort of thing has been done, machinery installed incorrectly or piping put in improperly because someone got off on the wrong track and was too stubborn and lacking in pride to make the correction.

Wrong Way to Fix Cracked Flange

The night (in port) engineer told of a hair-raiser which he had encountered. On one ship, a workman had incorrectly taken up on a high pressure flange on a steam line and had cracked the flange. Rather than replace it he had smoothed the crack over with graphite and left it. Had the night engineer not seen him do it, and reported the incident to the foreman, someone might have been seriously burned by the leak.

Porosity in Valve Body

Another item that was repaired while we were at the yard was the bypass valve for the tank cleaning heater reducing and temperature control valve. The bypass valve was a 2½ in., 600 lb std. cast steel globe valve, the body of which was porous with the result that the valve was leaking considerably. The valve body was chipped out and welded up but just a few weeks afterward it was necessary to have the valve chipped and welded in a new spot adjacent to the old leak.

Apparently there was a considerable amount of porosity in the casting. From observation during the war, it would appear that foundries generally suffered from inexperienced personnel. The troubles were certainly universal and not limited to the smaller companies. The valve in question, and another similar valve that developed porosity later on the trip, were both made by one of our foremost valve manufacturers. In both cases, the porosity was in the body near the top at the narrow section about an inch or two back from the flange.

$6000 Pump Damage

There were other routine jobs to be done on the ship such as cleaning the tubing and heads of the condensers, painting the hull, and checking the equipment but the major job developed while at the yard as the result of carelessness of the men on watch. Because of the use of centrifugal pumps for the cargo oil, it was necessary to keep these pumps as low as possible. To accomplish this, it was necessary to provide a 2 ft., 3 in. depression in the tank top (top of the double bottom) and the pump motors were located in the depression at the forward end of the machinery space. The pumps were located in the pump room just forward of the motors, and driven by shafts extending through stuffing boxes in the bulkhead.

In any case, the repair crew (according to the story we got) disconnected some cooling water piping in the lower machinery space and neglected to reconnect it before leaving for the day, or to secure the overboard isolating valves. Sufficient water was leaking into the ship to fill the depression in which the three 200 hp and the two 50 hp motors were located, by the time the water was discovered the following morning. Apparently the oiler who should have made the rounds to check everything either slept on the job or else didn't bother to check the lower machinery spaces, and the watch engineer didn't check on the oiler. (In American ports, and particularly under these circumstances—in a repair yard with the plant shut down—the watch officer is required only to be on board, on call for any emergency.) The bill for removing the rotors and for cleaning and drying the coils was well over $6000.

This type of accident with these ships was not uncommon, although the flooding water had in most other cases been caused by a break in the piping, damage to the ship or, most frequently, by a relief

THE AUTHOR of this article has been engaged in marine engineering for over 10 years, having been associated with Gibbs and Cox in New York; the United States Maritime Commission; and Marinship Corp., Sausalito, Calif. The latter was one of the four major yards engaged primarily in building tankers during the war. At Marinship, he was the assistant marine engineer, in charge of machinery and piping design, field engineering, and materials. Following the war, he went to sea as a junior third assistant engineer on two tankers to obtain experience and information as to the quality of the design, construction, materials, equipment and operation of this type of ship. The experiences on the first ship have already been related in the January and February issues of HPAC. The experiences related in this and in following issues of HPAC have to do with the occurrences on the second ship. This ship was a 6600 hp turbo-electric tanker, 523 ft long, and 21,880 tons displacement, with a cargo capacity of 140,000 bbl normal, or about 90,000 with the wartime armament and superstructure with which this ship was equipped. The ship was provided with two boilers operating at 450 psi and 730 F total temperature, a 5400 kw turbogenerator, and a 6600 hp propulsion motor, the latter operating at 2370 volts, at 93 rpm of the shaft. . . . In reading this report, it should be kept in mind that these ships were built under wartime conditions, by inexperienced workmen, and with the best materials available at the time. Consequently, as with all construction during the war, these ships did not represent the best of marine practice. Considering the circumstances under which they were built, they were remarkably good ships. Also, the crews on these ships were young and decidedly lacking in training and experience. But again, it should be remembered that somebody had to sail these ships, and these young men took on the task. The crew could not be regarded as being comparable to the normal peacetime crew of an oldtime operating company; the equipment and maintenance suffered accordingly. Of the crew of about 44 (it changed from port to port) only 11 men were over 24 years of age, only 10 were over 30, and only five were over 35

valve on the tank cleaning heater and fire pump (used for tank cleaning operations) which would relieve whenever the men shut off the tank cleaning system while the pump was in operation. The latter had happened often enough so that on later ships of this design the relief valve discharge had either been carried back to the pump suction, or else run overboard. In addition, a cofferdam was provided so that any minor amount of flooding would not immediately endanger the motors. There was a standing order that this cofferdam should be constructed on all of the ships of this type operated for the government when they were available for repair in port.

Steam Hose Causes Split Pipe

The only other item that required repair before we could get out of the yard was a frozen and split wash water pipe, which provided wash water to the midship quarters. Normally, any cold water piping running between the two deck houses would be provided with a steam "chaser," and would be lagged to prevent freezing. This pipe (a copper one) was not. To make matters worse, someone had drained the line to prevent freezing and then had attached a steam hose to it to be "sure it didn't freeze." It was the condensed steam, collecting at the aft end of the pipe just outside of the after deckhouse, that froze and caused the 12 to 18 in. long split.

When the major repairs were completed, we prepared to sail and moved out to an anchorage while the repair crew cleaned up and finished a few other minor items. It was about this time that a rather amusing incident took place. Having just left the ship where we had had difficulty in maintaining the proper lube oil temperature for the main turbogenerator and other bearings, I checked to see how the oil was making out on this ship.

The weather was still very cold. Observing that the temperature was a bit low, even though the main unit was idling at the time, I turned on a little steam heat on the oil gravity tank that supplied the bearings. Sometime later, much to my surprise, the oil temperature had dropped down again, so more steam was applied. This kept up for about a day, when it was casually mentioned to the third engineer. And then it came out! The latter had observed the oil temperature rising and had cracked the circulating valve to the oil cooler. Later, with the temperature rising again, he had opened the valve some more. So after awhile we were doing a good job of pouring heat in at the top, and removing it at the bottom, as the oil made its cycle from the pump to the cooler, gravity tank, bearings, sump tank, and back to the pump. Who knows . . . this may have helped to keep the bay ice-free.

BOILER CODE SECTION IS BEING REVISED BY ASME

The boiler code committee of the American Society of Mechanical Engineers recently announced that its special committee to revise section VIII of the ASME boiler construction code (unfired pressure vessel code) had completed its work and submitted a report to the boiler code committee in draft form as a proposed revision of section VIII, dated January 1947.

One of the features of the new draft is the development of a more logical arrangement of material, which closely follows that in the API-ASME unfired pressure vessel code. The basic minimum requirements are essentially those established in the alternate rules for unfired pressure vessels issued as a part of the 1944 addenda to the code. Besides improved arrangement, the proposed revision embodies the following: (1) Improved and extended rules for the design of formed heads under internal and external pressure; (2) provision for the design of cylindrical shells under external pressure at elevated temperature; (3) joint efficiency for fusion welded vessels established on a premium basis; (4) spot examination of fusion welded vessels as a minimum requirement; (5) incorporation of a nonmandatory appendix as a guide for the inspection of vessels in service.

The boiler code committee invites all interested persons to review the proposed revision and to submit comments thereon to the committee. The new draft is obtainable from J. W. Shields, secretary of the committee, ASME, 29 W. 39th St., New York 18, N. Y., at $1 per copy.

Unit Heaters Have Advantages in Many Heating Applications

By P. J. Menden, Young Radiator Co.

WITH THE GREAT amount of interest in various methods of heating industrial, commercial, institutional, and public buildings—and the consequent amount of attention devoted to the newer schemes—it is perhaps well to review very briefly some of the advantages of such well-established equipment as the steam or hot water unit.

IN THE LIGHT of current discussion and interest in new developments in heating methods, the author feels that this is an opportune time to stress some of the fundamental advantages of unit heating in commercial and industrial installations. This article makes no pretense to an exhaustive treatment of all the advantages inherent in unit heating, but is rather in the nature of a review—a reminder of important points to men faced with the responsibility of deciding between alternative heating methods.

The Industrial Heating Problem

A satisfactory method of industrial heating must cope with variable and fluctuating heat demands from working zones or areas. The charting of temperature needs by zones in a plant layout over a period of normal operation will reveal surprising hourly changes in heat requirements.

A high degree of zone or area temperature control is inherent in unit heaters. Individually or in groups—as complete systems or as auxiliaries to existing heating systems—unit heaters can be operated to serve the areas where heat is needed . . . . . *and only those areas.*

The speedy response of unit heaters (without presetting of controls) to heat demands caused by changes in outside temperature is particularly important to the maintenance of comfortable conditions in boundary areas of the plant layout and where there is frequent traffic between outside and inside plant areas. The ease and responsiveness of control are attained by simple thermostatic or manual controls.

The addition of simple accessories enables the unit heater to meet ventilating requirements invariably linked with industrial heating problems. The fans can be designed to provide the necessary changes of air per hour, and can be operated independently in warm months to provide cooling air circulation throughout the entire plant.

Types of Unit Heaters

Today's unit heating methods are the result of considerable practical experience and intensive effort aimed at attaining a high degree of correlation between requirements and performance. There are three principal types of steam or hot water unit heaters, each representing an engineering solution for a specialized problem involved in adequate industrial heating, with various features available on the different types to make for a wide flexibility in choice of this heating method.

The most familiar is the conventional horizontal discharge propeller type. This is the original type of unit heater in which heat discharged is aimed at the zone of operation requiring heat. It has a wide application in factories, garages, stores and warehouses—in fact, wherever quick pickup in heat is desirable or essential. Slow speed motors provide quiet operation and make feasible the use of this type of unit heater in showrooms, offices, lobbies of public buildings, etc. It is frequently used to supplement other heating equipment in peripheral areas subject to temperature fluctuation due to opening and closing of large doors.

The vertical discharge unit heater was introduced shortly after the horizontal type in order to meet problems peculiar to structures with high ceilings. Stratification of heat in layers close to ceilings is a common phenomenon in such structures. The vertical discharge units operating from heights ranging to 40 ft overcome stratification and reduce the temperature difference between floor and ceiling. The result is a considerable saving in fuel costs along with an adequate heat distribution pattern.

Large open spaces create a special problem, and one which is solved by the use of squirrel cage type blowers. Here the need is for large and concentrated volumes of heat with a uniform distribution. The high velocity blower type unit heater has the reputation of being a most efficient and economical piece of industrial heating equipment.

Low Costs

Fewer valves, traps, and radiator connections, less elaborate controls, a greatly simplified system of piping, and low weight of the heating surface in relation to its capacity account for the low initial cost of unit heating systems. But comparisons on the basis of original cost cannot tell the whole story. Maintenance costs must be considered. Here accessibility and simplicity pay off.

Fuel costs are proportional to heat distribution. Any waste in heat distribution results in an increased cost burden and is inevitable unless heat is supplied directly to—*and only to*—areas where it is specifi-

Speedy response of unit heaters to heat demands is important

cally needed. By providing easy control over heat in any area, unit heaters give close correlation between performance and requirements for heat and thus save fuel.

Since industrial plant layouts are rarely static, and new machines and/or new manufacturing techniques impose a new set of heating conditions, the cost of future alterations in the heating system must be seriously considered in comparing alternative methods.

Obviously in such contingencies the unit heater offers unequalled advantages, for heat distribution patterns are easy to relocate or redirect in order to meet the new comfort requirements. In addition, unit heaters do not form obstacles to the use of any floor space. All of the production area is available for assignment to manufacturing purposes without being limited by consideration of possible effects on permanent heat distribution patterns.

Conclusion: Three Principal Advantages

Engineering experience and practical judgment can only conclude that these advantages are fundamental to and unique with unit heating. The author is convinced that unit heating offers (1) effective heat distribution and control, (2) low installation, operation, and upkeep cost, and (3) flexibility to meet the ever-present possibility of changes in heat distribution patterns.

SOLAR HEAT USE SAVES HEATING FUEL

It was mentioned in the December issue that a report on solar energy for heating (No. PB-25375, $1.50) is available from the Office of Technical Services, Department of Commerce, Washington 25, D.C. Orders should be accompanied by check or money order payable to the Treasurer of the United States. It describes the construction and operation of two solar heat collectors developed at the Engineering Experiment Station of Colorado.

The principle on which this collector operates was devised by K. W. Miller, former consultant to OPRD (now the industrial research and development division of OTS). The actual development work was under the supervision of Dr. George O. G. Lof, associate professor of chemical engineering at the University of Colorado. Rights in Professor Lof's design patent, recently applied for, have been assigned to the university, as have those under Mr. Miller's basic patent application.

The heat collector consists of a group of partially blackened overlapping glass plates, mounted on a roof. The arrangement is similar to that of shingles, separated by small air spaces. A glass cover over the staggered plates is employed to keep out dirt. By virtue of the high transmissivity of glass for solar radiation, and its low transmissivity for long wave thermal radiation, the black and clear glass surfaces in the unit become heated when exposed to sunlight, and the reradiated heat has no avenue of escape. Air passing between the plates is heated from the trapped heat of the sun. Experiments prove that heat can be collected at a higher temperature level by this method than can ordinarily be attained by other types of solar collectors.

The experimental installation saved 20 per cent of the fuel that would otherwise have been needed during the test period. The authors of the report state that a more efficient unit, currently being designed, could save up to 60 per cent of the fuel requirements.

For most efficient operation, the investigators state, ducts should be thoroughly insulated, and a method of storing the heat for a maximum economical period of one day should be developed. It is estimated that a storage bed containing about six tons of dry solids would suffice. If the air were recirculated between the collector and the storage unit, the storage bed might be appreciably smaller. Experiments on the storage bed are being conducted by the investigators at the University of Colorado.

Locations north of the 40th parallel are generally unfavorable for economical solar heating, the report states. Because of the possibility of using solar heated air to operate an absorption type of air conditioner, it is felt that the greatest applicability of this system would be in the South.

Starts Standardization of Stainless Pipe & Fittings

HPACCNA Reports on Status of Program Initiated at Its Last Annual Convention

STAINLESS STEEL was one of the liveliest subjects discussed at the annual convention of the Heating, Piping and Air Conditioning Contractors National Association held at Atlantic City last May, and a resolution adopted at that meeting provided for the association initiating "acceptable dimensional standards for stainless steel pipe and fittings." This report — taken by permission from the HPACCNA's Official Bulletin—describes the status of this project, and was published so that readers could submit any comments they wished considered to the association's national office, 1250 Avenue of the Americas, New York 20, N. Y., or to the chairman of the association's committee on standards, Paul A. Edwards, 608 Wabash Bldg., Pittsburgh 22, Pa.

INCREASING USE of alloy steel piping in recent years developed a standardization problem which was referred to the committee on standards of the Heating, Piping and Air Conditioning Contractors National Association for action. At the last annual convention at Atlantic City it was resolved that the necessary work be started to create and sponsor in conjunction with recognized agencies (including the American Standards Association) acceptable standards for stainless steel pipe and fittings. This standardization problem will also apply to piping systems fabricated from other less commonly used metals and alloys, but the specific problem discussed at the Atlantic City convention referred to the so-called "stainless steels."

The ever increasing use of high alloy steels for piping systems serving various chemical and process industries (such as synthetic rubber, petroleum, food and dairy, rayon, pharmaceutical and many others) is creating an increasing demand on the manufacturers of welding fittings and pipe; so much so that stainless steel fittings and pipe are now manufactured for warehouse stock purposes as well as being manufactured to meet special orders as was previously more prevalent. Several of the manufacturers involved indicate that a major proportion of their future annual production expressed in dollar value will be of the stainless steel types and they are already in production in many sizes and alloy types.

As recently as 25 years ago "stainless steel" referred to one commonly used alloy with corrosion resisting properties, an alloy containing 0.35 per cent carbon and 13.5 per cent chromium. This is the original cutlery type of steel which was very popular for use in manufacturing knives, scissors, dental and surgical instruments, etc. Today there are over 60 different alloy steels in common use which offer many advantages of heat and corrosion resistance.

The most popular groups at present serving the piping industry are the 18-8 chromium-nickel types and apparently the major demand at present is for types 304, 316, and 347. Type 304 is the popularly used stainless steel readily adaptable to welding, bending and forming. Type 316 is more corrosion resistant due to the addition of 2 to 3 per cent of molybdenum. Type 347 is a "stabilized 18-8" involving the addition of 1 per cent or less of columbium. This addition of columbium prevents susceptibility to intergranular corrosion through carbide precipitation during heating in the range of 575 to 1650 F and is thus more suitable for general welding use. Other alloys will find increasing use for piping as the availability of pipe and fittings is improved. Increasing the chromium percentages improves the oxidation resistance and more nickel is used to obtain greater strength at elevated temperatures.

The 18-8 alloys as well as the higher chromium-nickel alloys thus offer many advantages not available in other piping materials to withstand attack by corrosive agents and to maintain acceptable physical characteristics at elevated temperatures as well as subzero temperatures. Some of these alloys retain suitable strength and resistance to heat oxidation at temperature as high as 2000 F, which make them especially suitable for use around furnaces, heat exchangers, and high temperature catalytic cracking equipment.

It is, however, the corrosion resistant properties of the stainless steels that make their use so advantageous for piping in the chemical and food handling industries, not only because of their resistance to attack by various acids and other corrosive fluids, but also because of the extremely passive nature of the metals which prevents contamination of the fluids conveyed by the piping systems.

Heretofore in the use of these materials in piping systems at elevated pressures and temperatures the designing engineer was guided by the ASA B31.1 Code for Pressure Piping in determining the proper wall thicknesses for piping and fittings. However, due to the high comparative cost of the material involved, and when operating

pressures and temperatures permitted the designing engineer specified walls of the minimum thickness possible to save weight and thereby cost.

Since several of the manufacturers involved have been supplying stainless steel welding fittings in standard weight (schedule 40) and extra strong weight (schedule 80) for sizes from ¾ to 8 in., the need for standardization principally applied to agreement on a table of thicknesses of pipe and welding fittings operating at pressure and temperature levels below that which would require schedule 40. This standardization would thus provide the designing engineer with a stock source of pipe and welding fittings which could be used at these lower operating levels, be classed as standard, and still make an appreciable saving in cost over the use of schedule 40 weights.

It was this problem that was reviewed in a preliminary way by the HPACCNA's committee on standards at their meeting in Cleveland in September, which in turn resulted in a meeting with tube and fitting manufacturers at Pittsburgh in November. The tentative conclusions reached at that meeting are now being circulated among the various manufacturers and other interested parties involved prior to formal submission of the standardization problem to the American Standards Association by the Heating, Piping and Air Conditioning Contractors' National Association, the initiator of the movement for standardization of this material.

TENTATIVE TABLE OF STAINLESS STEEL PIPE SIZES AND WALL THICKNESSES

Pipe Size (IPS)	Outside Diam. (inches)	Wall Thicknesses (inches) (a) Lt. Wt. (Sch. 10)	Std. Wt. (Sch. 40)	Ex. S... (Sc... 80)	Wt.
⅛"	0.405	(a) 0.049	0.068		.095
¼"	0.540	(a) 0.065	0.088		.119
⅜"	0.675	(a) 0.065	0.091		.126
½"	0.840	(a) 0.083	0.109		.147
¾"	1.050	(a) 0.083	0.113		.154
1"	1.315	0.109	0.133		.179
1¼"	1.660	0.109	0.140		.191
1½"	1.900	0.109	0.145		.200
2"	2.375	0.109	0.154		.218
2½"	2.875	0.120	0.203		.276
3"	3.500	0.120	0.216		.300
3½"	4.000	0.120	0.226		.318
4"	4.500	0.120	0.237		.337
5"	5.563	0.134	0.258		.375
6"	6.625	0.134	0.280		.432
8"	8.625	0.148	0.322		.500
10"	10.750	0.165	0.365	(c)	0.500
12"	12.750	0.180	(b) 0.375	(c)	0.500

Note (a) These wall thicknesses were computed from the ASA B36.10 formula for schedule 10:

$$t = \frac{\text{Sch. No.} \times \text{Diam.}}{1750} 0.100$$

Wall thicknesses for ¾ in. pipe and smaller do not conform to this formula. Schedule 10 thickness is not recommended for threaded connections.

Note (b) Thickness does not conform to schedule 40.

Note (c) Thickness does not conform to schedule 80.

The following conclusions were reached and tentatively agreed on concerning the standardization of stainless steel pipe and fittings:

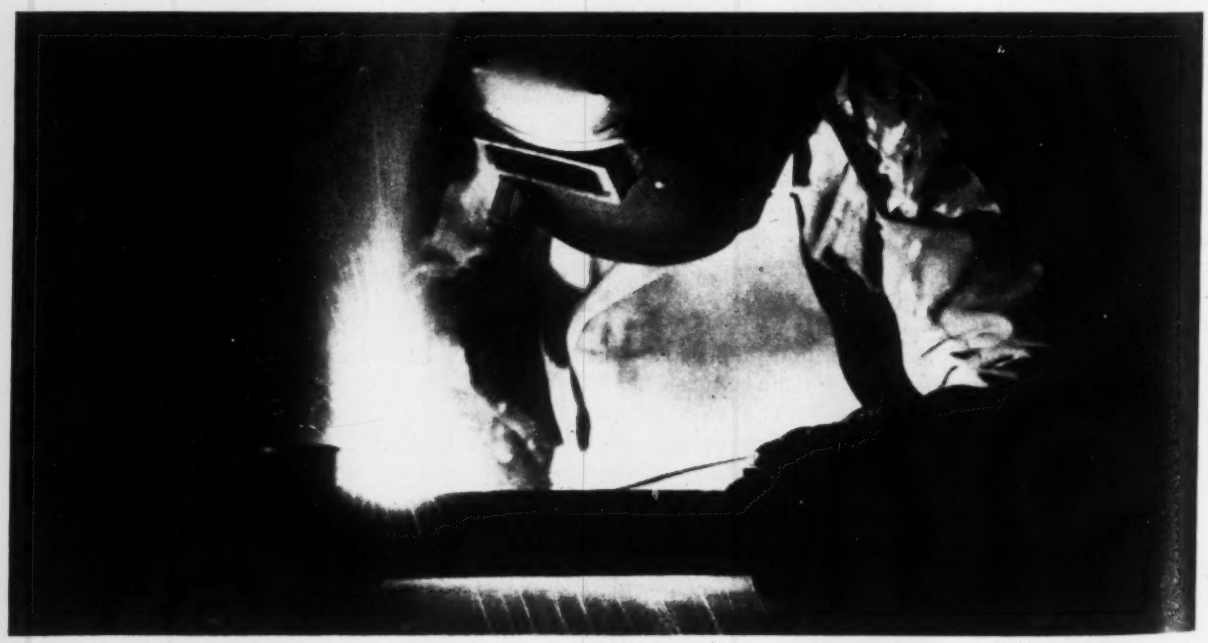
1) That the outside diameter for "iron pipe size" be used for all pipe from ⅛ to 12 in. inclusive.

2) That three weight classifications of piping in the above sizes be established as standard, as follows:

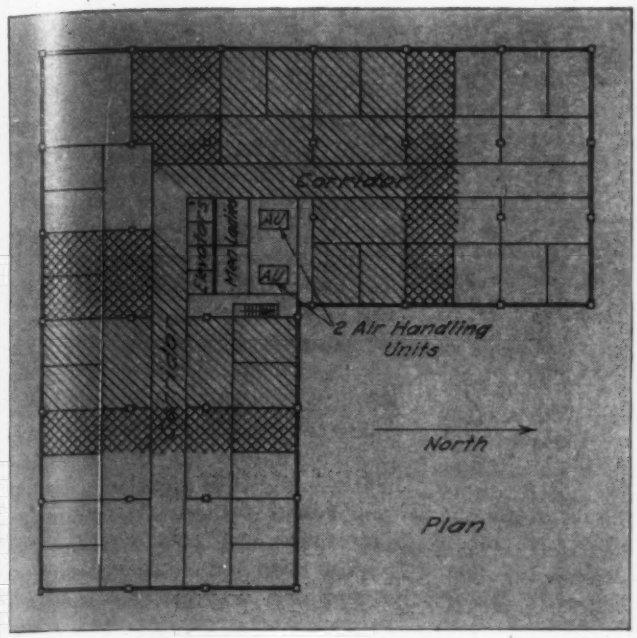
Extra strong weight . . . (Schedule 80)
Standard weight . . . . . (Schedule 40)
Light weight . . . . . (Schedule 10)

3) After discussion agreement was reached on the use of the AISI wall thicknesses for light weight pipe and some modifications to schedule 40 and schedule 80 for 10 in. and 12 in. for the other two classes of pipe. Based on the above discussions, the wall thicknesses shown in the table were agreed on.

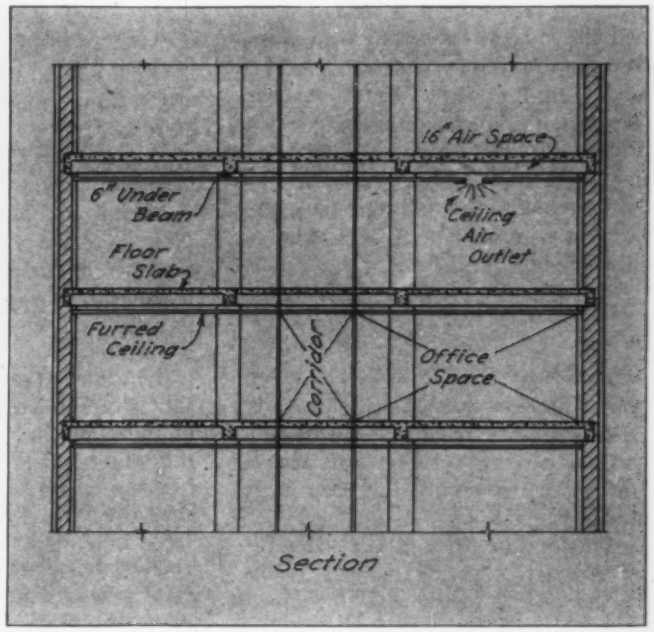
4) It was agreed that the problem of manufacturing specifications, tolerances, etc., for this type of piping was beyond the scope of this meeting. The AISI representatives proposed that a review of the specifications for austenitic pipe, as now covered by ASTM specification A-158 (alloy pipe), would be made for the three types of stainless steel generally considered.



Crane Research Laboratories photo



The shaded areas show where radiant cooling occurred; no effect was noticed in the plain areas. Some few rooms—noted by double hatching—were at inside conditions for summer comfort



It was thought by the design engineers that cold air could be pumped into the space between each floor and delivered through holes in the ceilings

Can't See Radiant Cooling

BY WILL D. SAMPSON

I MAY BE mistaken, but I can't remember ever hearing or reading very much about methods of radiant cooling. Almost every speaker or writer on the subject of radiant heating goes on in great detail on that phase, and then says "Cooling is effected by pumping chilled water through the same pipes."

From Switzerland, Norway, and other countries come accounts of successful installations of radiant cooling, and it is explained that the designing engineers have studied the weather charts for years and have found they can carry the panel temperatures sufficiently high to prevent condensation and still give comfortable conditions. Here in the United States the outside average summer design conditions could be set at 95 deg dry bulb and 78 deg wet bulb. These conditions vary to some extent up or down in various parts of the country but for the sake of this article let us consider them correct.

By the radiant method of cooling the dry bulb only is affected and reduced. It has already been proved that comfort conditions, as far as the human system is concerned, are affected by a combination of both relative humidity (a function of wet and dry bulbs) and the dry bulb temperature. With the reduction of the dry bulb only there will be an increase in the relative humidity. The relative humidity will continue to increase until condensation occurs—where, so long as the temperature remains constant or lower, it will remain.

THE AUTHOR—who has had considerable experience in air conditioning work and has recently reopened his consulting engineering office—is skeptical about the possibilities of radiant cooling. He discusses here the case of a multistory building where a radiant cooling effect was unintentionally obtained . . . His remarks on the subject may start an argument between proponents of the method and those who feel as does Mr. Sampson. Comment will be most welcome, for—as Mr. Sampson points out—only in such a way can good conclusions be drawn.

From exhaustive experiments in the past and by the installation of thousands of conventional summer cooling systems, it is known that at an 80 deg dry bulb the relative humidity should not exceed 50 to 55 per cent to obtain maximum comfort. With the average relative humidity at so high a level it is difficult to understand how, if panel temperatures are sufficiently high to prevent condensation, the dry bulb could be lowered enough to become effective. To overcome this, of course, the panel coils could be so arranged as to carry off condensation without harm to the building structure through suitable

troughs. However it is designed, in a room cooled by the radiant method without the aid of ventilation the relative humidity would be at or near saturation. The immediate conclusion to draw is to supplement radiant cooling with ventilation air that has been properly dehydrated to overcome the objections of high relative humidities.

Turned Out to be Radiant Cooling

There was a building in which a summer cooling system was installed that, while it was not intentionally designed as such, turned out to be a radiant cooling system. This was a multi-story office building in a large mid-western town.

This building had an air space between each floor, occasioned by the furred ceiling below and the immediate floor slab above, of about 16 in. It was thought by the design engineers that cold air could be pumped into the space and then by simply cutting holes in the furred ceiling and attaching a grille thereto, air could be delivered without the use of duct work. If such a system could be successful, the immediate savings in duct work alone—not to mention plastering, painting, noise of erection, etc.—would have been tremendous. The air was delivered all right, after it had given up its cooling effect "radiantly" through ceilings and floors near or adjoining the rooms used for the units. The shaded areas on the floor plan indicate where radiant cooling occurred, and the plain areas shows where no effect of any kind was noticed.

In the rooms near the units, moisture condensed on the cold floors and ceilings. This was remedied by proper insulation which extended the shaded area somewhat but radiant cooling was still apparent. This caused typewriters, metal desks, surgical instruments, and other metal objects to take on a film of moisture and deterioration in the form of rust was apparent. In the extreme ends of the building's two wings, there was no cooling effect at all even though there was plenty of air entering these rooms through the ceiling outlet. This proved that the air had given up its energy back the line in the form of radiant cooling.

Some few rooms—noted on the plan by the double hatch lines—were at inside design conditions for summer comfort. Yet in these rooms one did not feel the effect or relief experienced in the ideal air conditioned space. The occupants of the building suffered from varying degrees of discomfort. The air seemed to weigh heavily upon you in a depressing way. From an air conditioning point of view there was a sufficient amount of air entering each room but it did nothing to relieve this uncomfortable feeling even when the air quantities were doubled.

This situation was corrected by rather unique means. The ceilings in the corridors were removed and the floor slabs on the under side heavily insulated and troweled smooth. The walls of the corridor were extended up to the floor slab above and plastered smooth. The ceiling was reinstalled 8 in. lower than the finish ceiling line in the offices and plastered smooth on both sides. Sheet metal duct work was installed between the air handling units and the "duct" in the corridor ceiling. In the office space a non-metallic duct 6 in. deep was installed tight to the ceiling and cut through to the corridor "duct". By proper vanes, splitters and other duct controls, air was delivered in the proper portions and the loss in temperature did not exceed 3 deg from the unit to the most extreme end. The system then resembled any conventional air conditioning installation, temperatures and humidities were satisfactory, and all objections were overcome.

All that can be said of this system as it was originally designed is that it was a radiant cooling system, and it left the occupant feeling not a great deal unlike an oyster must feel covered as he is with a film of moisture. The sensible temperature was well down below outside conditions, the relative humidity approached 100 per cent in most areas, the moisture could not evaporate from the body, and the human system—intricate as it is— could not properly regulate its temperature to a point of comfort.

Comments Welcome

These have been my experiences with radiant cooling and they have not been successful. I have not closed my mind on the subject for I don't believe all the facts are in as yet. Comments would be most welcome, for only in such a way can good conclusions be drawn.

HEAT PUMP COOLS SUBMARINES

The Germans made use of the heat pump, or reverse refrigeration cycle, to cool submarines in tropical seas and to heat them in colder seas, according to a report on German marine refrigeration (PB-44666; photostat, $4; microfilm, $1) for sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C. Moisture which condensed in cooling the air inside the submarine was collected for drinking water.

According to the report, a new method was used for the control of compressor capacity in marine refrigeration. A solenoid kept the poppet valve of the compressor open during the first part of the compressor stroke. The solenoid was in turn controlled by a pressurestat so that the amount of time the valve was kept open depended upon the pressure. The method was claimed to control temperatures within precise limits and without frequent starts and stops of the motor; it also maintained a better balance within the refrigeration system. The device is known as the Glaessel-Linde automatic capacity control.

Condensers were found to be cooled with sea water pumped through at the rate of not more than 200 fpm. The slow speed prevented the corrosion which occurred when cooling water was circulated more rapidly.

Orders for the report should be accompanied by check or money order payable to the Treasurer of the United States.

ASME HONORS MORRIS E. LEEDS

Morris Evans Leeds, pioneer in the development of modern electrical instruments and in the field of industrial relations, recently received the highest honor of the American Society of Mechanical Engineers, the ASME Medal. The medal was presented by D. Robert Yarnall, ASME president, at the society's annual banquet.

Mr. Leeds, founder and chairman of the board of the Leeds & Northrup Co., is the inventor of a basic element in the automatically operated, balanced current, recording and controlling instruments that have become indispensable in modern industry.

Boilers, Conditioning Equipment Hoisted to Top of Big Building

SUNDAY, FEBRUARY 9, with temperatures hovering around 20 F and a stiff north wind, saw the starting at the Kirby building, Dallas, Texas, of a most unique mechanical engineering job. This 16 story building—in the Akard St. canyon of downtown Dallas—has been supplied with steam from the neighboring Hotel Adolphus, which service is now being discontinued. In the original construction, no provisions for a basement nor a boiler stack were made. Zumwalt & Vinther, designers of the new year 'round air conditioning system for the building, conceived the idea of installing the boilers and attendant equipment on the roof of the building.

Martyn Brothers, Inc., of Dallas, mechanical contractors of 32 years experience, were awarded the contract. This firm, headed by Henry J. Martyn, has handled many unusual installations. C. R. Gardner, vice president of the company, worked out the details of hoisting the two 9 ton boilers from the trucks on Akard St. to their position on the Kirby building. The crew of steel workers was under the supervision of C. B. Rains, who is quite adept at the dangerous task involved in working from an I-beam extending out over the street. Martyn Brothers' forces, under the direction of Mr. Gardner, consisted of J. T. Halbrook, heating superintendent, Fred Fehmel, heating foreman, and Jas. O'Connor, engineer.

225 Foot Hoist

Preliminary preparations were made well in advance in order that the actual hoisting could be accomplished in one day, and since Akard St. is one of the main crosstown arteries of the city, it was necessary to execute the work on a Sunday. Special insurance against all possible hazards was arranged in an amount exceeding half a million dollars. Work was begun at 9:00 in the morning and by 10:30 the shell of the first boiler had started the 225 ft journey to the hoisting beam on the top. This trip required 19 min.

Upon reaching the top, the load was transferred to a rolling dolly, which was then pulled over the cornice of the building on the hoisting beam and then lowered onto rolling cradles to be carried into the machine room previously constructed on the top of the building. After the 10,000 lb shell was hoisted, the 8000 lb firebox was raised in the same manner, as were the two parts of the second boiler.

After the boilers were landed additional equipment—fans, dehumidifiers, heat exchangers, heating coils, etc.—were raised by the same means. Rigging was changed to suit the lighter weight of these items, and the trip was accomplished in about 5 min. Despite the extreme cold and high winds the entire program was completed without mishap.

The boilers will be fired with natural gas and provision for standby oil firing will be made. Induced draft fans on each boiler provide necessary draft, and the 6 ft stacks serve only to project the flue gases through the machine room roof.

Piping Changes

The radiators and all steam piping will be removed from the upper 11 floors of the building and replaced with a year 'round conduit system of air conditioning. The existing main steam riser will be connected to the boilers and thus reverse the direction of flow of steam to supply the lower five floors of the building. Condensate from this section will be pumped to receivers in the machine rooms, and thence returned to boilers through automatic pumps. The refrigeration machinery—with a capacity of 350 tons and consisting of a motor driven centrifugal compressor, condenser, cooler, and heat exchangers—will be hoisted at a later date. At the same time a 1000 gpm induced draft cooling tower will be hoisted and placed on special steel grillage already erected for that purpose.

Heating and cooling of the upper section of the building will be accomplished with the use of water circulated through heat exchangers to each of the three zones of the building. The circulating lines will be of copper and will be placed in approximately the same position as the original steam risers, which will be removed. Temperature control will be accomplished through the use of exterior thermostats controlling three-way mixing valves in the water circuits supplying each zone.

The interior offices of the building will be air conditioned by means of a conventional system of duct work supplied by a dehumidifier in the penthouse machine room.

After the 10,000 lb shell of the first boiler was hoisted, the 8000 lb firebox was raised in the same manner, as were the parts of the second boiler

SAM LEWIS' PAGE

***IN THIS** regular feature, informal comment on heating, piping, and air conditioning matters is given by Samuel R. Lewis, consulting mechanical engineer and a member of HP&AC's board of consulting and contributing editors*

Filing Plans in an Engineering Office

THIS IS WRITTEN in a selfish mood, to set down some of the little things that must be lived with by an engineer; and perhaps to aid in their solution by naming them or to evoke aid in solution from the friends who read this.

We moved our office so as to gain more space and so as to throw away several years' accumulation of defunct correspondence. I can't throw away old specifications of completed plants because additions keep coming up, and because they form the best possible record for the inevitable repairs and improvements that buildings seem to require. I did throw away several hundred pounds of expensively printed war housing specifications hoping that those housing and trailer projects, once built and lived in, will go forever into the limbo of forgotten things.

Drawers for Plans

I rebuilt again the often moved and often rebuilt chests of horizontal drawers for plans. The chief engineer of a manufacturing plant can insist on uniform sizes of drawings and has a chance at least to keep only the tracings. A consulting engineer is compelled to use the sizes of drawings furnished by his clients, and as he frequently gives the client the tracings, his plan filing problem is difficult. He receives on many projects the blueprints of preliminary architect's sketches and usually is smart if he saves them until the final plans are made. They accumulate and they curl up and they get lost, and their filing and storage and ultimate consignment to the incinerator frequently involve risk of embarrassment when the old drawings "turn up absent."

We tried clipping all the blueprints of large projects to binding rods, laying the rods in indexed slots so that the drawings hang inside vertical cabinets. It is hard to prevent dust from accumulating in such enclosures, and it is a serious task to pull out each set for reference and to rebind the great thick mass every time a new drawing must be added. The old fashioned flat drawers seem to be best, even though the drawings in each drawer may be any size from 60x36 in. to 12x24 in., and the little ones like to hide under the big ones, and there is an occasional big one that refuses to enter the drawer.

After a project is finished, the drawings have to go to storage, which should be dustfree, fire resisting, and yet easily accessible. We have a series of sheet metal troughs for this purpose, enclosed in a dust-tight cabinet. I am the one (having the broadest shoulders to bear possible complaint therefrom) to take the responsibility for destroying all the drawings except those vital for occasional reference or for additions perhaps 10 years or more ahead.

***HOW TO PRESERVE** drawings, blueprints, and specifications in the engineering office is an engineering problem in itself of no small magnitude! Mr. Lewis takes time off this month from discussing the problems met with in the plants and buildings of a consulting engineer's clients, turns his attention to the mechanical facilities of his own headquarters. We are sure that other consulting engineers, contractors, engineers in industry, and building engineers will find his remarks helpful, will perhaps contribute their ideas on the subject for publication.*

We make these transferred drawings into rolls up to about a foot in diameter, index them in a book, and slip them into one of the metal troughs. I have known successful and careful contractors who fold every sheet of a big set of plans separately to 11x14 in. size and file them in cardboard transfer cases. This little job is not very satisfactory for projects having 50 sheets of heavy blueprint paper, each sheet perhaps 5 ft long.

Years ago I tried clipping the old drawings together with grommets and hung them on hooks on sheet metal doors, the doors hinged at one side. This scheme worked well but the fire hazard was great and the space occupied was tremendous.

I'm About in the Market for Microfilm

I think I am about to be in the market for microfilm or some other photographic method of saving old plans, so that the troublesome old blueprints can be destroyed. The relatively recent introduction into an engineer's life of photography is worthy of many kind words.

Inked drawings on tracing cloth are almost obsolete. It is practicable to make a drawing in pencil on paper and to obtain therefrom excellent duplications, either in white lines on a blue background or with colored or nearly black lines on a white background. It is possible also to make, from these same originals, prints on transparent paper upon which alterations and additions can be drawn, erasing chemically any undesired lines or letters, and then to duplicate these. It is also possible by the aid of photography and chemistry to make black line drawings on cloth that simulate inked plans on tracing cloth, from originals that are penciled on paper.

If the original pencil drawings are perfect, this photo-chemical process will be acceptable. If, however, the penciled lines vary greatly in intensity or if there are imperfections in the paper of the original drawing, of course the photograph will perpetuate them and retouching will be necessary.

Thirty years ago there was a trend toward the hectograph method of plan making. Various colors of water-soluble ink were employed on the tracings. These were laid on a glycerine and water-impregnated pad on the surface of which part of the ink was transferred and from which a limited number of copies could be printed. Occasionally we must refer to one of these old drawings. The colors usually are legible but the paper refuses to lie flat and it cracks if forced out for tracing. I am thankful that this scheme of plan duplication is no longer practiced.

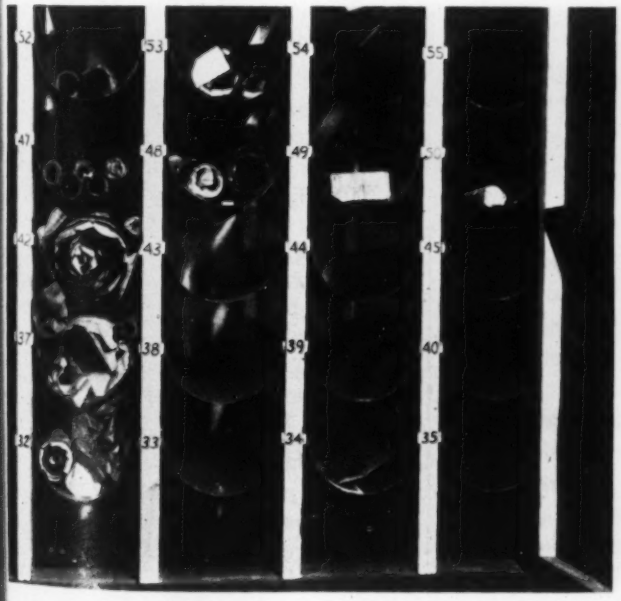
Glass Topped Table a Handy Tool

One of our handiest tools is a ground glass topped table fitted with a group of tubular vapor lamps under the glass so that the weakest sort of blueprint easily can be traced.

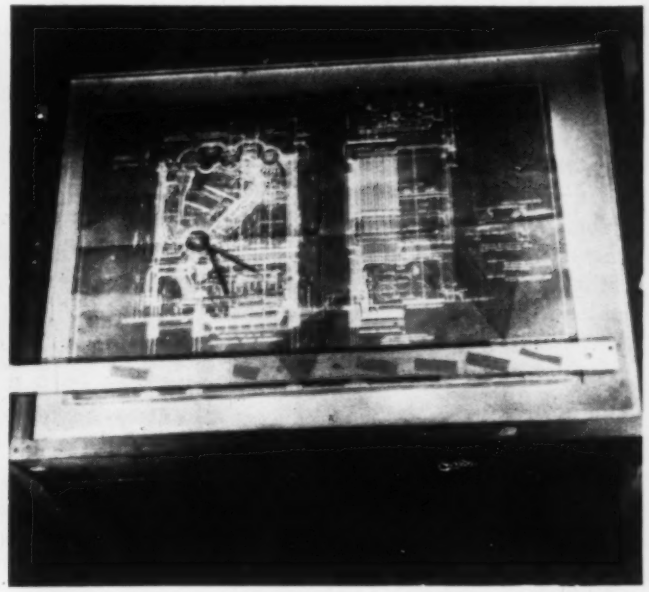
We use many photostats, especially for ammunition in backing up our recommendations to clients. For example, a relatively small photograph of the elaborate original drawing of an old boiler plant can have drawn upon it the outline of a proposed new boiler—permitting convenient visualization of both equipments.

The thumbtack of time-honored memory is almost a thing of the past, since its use ruined the corners of many plans, wore down depressions in fine drawing boards, and—when encountered point up—drew blood and thunder from the draftsmen. Scotch tape from one of our clients seems to have abolished the "dangerous thumbtack."

Words cannot express my feelings toward the rare client who insists that specifications shall be typed on 8½x14 in. sheets that will not fit into standard filing drawers designed for 8½x11 in. paper. I wish this guy had to sleep in a bed 2 ft shorter than *he* is!



We have a series of sheet metal troughs for storing drawings, enclosed in a dust-tight cabinet



Photos by A. Boome, Jr.

One of our handiest tools is a glass top table for tracing even the weakest sort of blueprint

Data on Heat Loss from Underground Walls Given in Air Conditioning Report

A COMPLETE REPORT of the methods used and results obtained in the air conditioning of an underground storage area in Britain, where high explosives were maintained in first-class condition for long periods, was given in vol. 14, no. 137, of the Journal of the Institution of Heating and Ventilating Engineers.

Abandoned underground workings of certain stone quarries, some 80 to 100 ft below the surface and covering an area of 50 acres, were to be utilized by the British war office for storing explosives but early tests showed that the air in the workings had a constant temperature of about 49 F and a relative humidity close to 100 per cent all the year 'round. Since the optimum storage conditions were found to be about 75 per cent relative humidity at a temperature above 55 F but not over 60 F, control of the atmosphere in the storage areas was essential.

In experiments conducted in 100 ft by 100 ft trial areas, it was found difficult to estimate the heat losses since the thickness of the walls was infinity, the exposed surface of the rock varied from very rough to quite smooth, and the rock had a variable moisture content. This latter factor had a far greater influence on the heat losses than either the roughness of the surface of the rock walls or the velocity of the air past the walls.

From a series of tests in an experimental chamber over several months, there was finally evolved a combined conductance and convection coefficient of 0.2 Btu per sq ft of surface per hr in damp areas, and about 0.15 in dry areas. Heat losses were calculated on the basis $H = Af\,(T_1 - T_2)$, where H is heat loss in Btu per hr, A the total area of surface in sq ft, f the combined coefficient, and $T_1 - T_2$ the temperature difference between air and rock face.

In the first attempts to dry by means of conditioned air, a steam air heater and fan delivered air at 71 F dry bulb and 75 per cent relative humidity to the storage space. Within 1 hr of shutting down the plant, however, the air in the area reverted to 100 per cent relative humidity, and higher temperatures only increased the evaporation of water from the surface of the rock. A silica gel adsorber dehumidifying plant was then installed and set to deliver air at 50 F and 65 to 70 per cent relative humidity but it required too much cooling water for the conditions prevailing and this method had to be abandoned.

Tests were made using waterproofing paints on the surface of the rock, and it was found that with treated surfaces the heat losses increased due to conduction through the water-saturated rock behind the waterproofing, as compared with untreated rock through which the heat losses decreased as the water was evaporated and the rock became dryer. After testing various waterproofing materials for their ability to reduce the evaporation and, by sealing the pores of the stone, prevent capillary action, one having a silica base was found which had an efficiency of over 80 per cent when sprayed on, and which gave a hard, glossy, white surface.

Two large test areas, each of approximately four acres, were conditioned by blowing 150,000 cfm of air drawn from large disused workings in which the ambient conditions were 48 F and 100 per cent relative humidity, up a passage 12 ft by 10 ft, running some 500 ft along the whole length of one side of the test areas. The passage acted as a plenum chamber; nine air heaters were set in one wall, and rectangular ducts set on the farther side of the wall carried the heated air right across the areas. The air was distributed through suitable openings in the sides, adjustable sliding shutters being used to balance the flow. The air was exhausted at floor level and drawn up to the surface by a vent shaft with an exhaust fan on the top. Balanced air pressure was maintained in the area.

Following the successful operation of these large test areas, a further area of 10 acres was air conditioned; but since there was no large area available to act as a "cold storage reservoir," mechanical refrigeration in the form of a 375 ton ammonia machine was used. This machine and the method of operation are described in detail in the paper.

Underground, a 100 in. fan handled 230,000 cfm against 2 in. static. The main heater had a capacity of 200,000 Btu per min and was fed by a 10 in. steam main from the engine exhaust. Parallel to the heater there was an air washer fed with 2400 gpm of chilled 34 F water, from which the air left saturated at 36 F. The conditions maintained in the area averaged 60 F dry bulb and 53 F wet bulb.

In the course of the discussion, it was pointed out that there were numerous instances in which a temperature of about 50 F had been found in underground areas and that this seemed remarkably constant from the Arctic Circle to the Mediterranean.

CYRIL TASKER, director of research of the American Society of Heating and Ventilating Engineers, reviews here a recent British report on the air conditioning of underground areas for wartime storage of high explosives. . . . Information on the method of controlling temperature and humidity and data on wall heat losses are given.

"OPEN for DISCUSSION"

WE FOLLOW here the custom of engineering society meetings in allowing a period for questions and answers and comment following the presentation of a paper. You are invited to contribute your views on published articles, other matters of importance

Suggests Graphs or Charts for Data on Wood Heat Conductivity

THE EDITOR—The following comments are offered relative to the data sheet entitled Conductivities and Conductances of Building Materials and Insulations, by Paul D. Close, in the February HPAC.

Mr. Close has selected conductivity values for most of the wood species listed in Table 3 at two different densities and three different moisture content levels. This form of presentation is obviously more satisfactory than the practice of merely listing a conductivity value for a species without indicating either the moisture content or density upon which the conductivity value is based (see Yellow Pine, Table 3, page 100, February HPAC).

Various investigators* have shown that the heat conductivity of wood is dependent primarily upon its density and moisture content, and the relation between conductivity and these two variables has been expressed by means of alignment charts, graphs, and equations. Individual species vary in conductivity within relatively narrow limits about the values anticipated on the basis of moisture content and density alone. Since available data show that deviations in conductivity from those anticipated values are fully as pronounced in the wood of a single species as those that appear to exist between different kinds of wood, it would seem that a graph, alignment chart, or equation is the most practical way to present conductivity data for wood.

Such an approach would offer several advantages: (1) For general use it would permit the average value for density of a species (not given in Table 3) to be used as the basis for expressing the average conductivity value for that species at one or more levels of moisture content. (2) It would permit application of available data to species not listed in Table 3 provided the density of wood were known. (3) It would permit the user to determine readily the heat conductivity of a species listed in Table 3 but of other density or moisture content values than those shown. (4) It would give recognition to the basic factors involved.—FREDERICK F. WANGAARD, assistant professor of forest products, Yale University.

*F. B. Rowley, The Heat Conductivity of Wood at Climatic Temperature Differences, ASHVE Journal Section, Heating, Piping & Air Conditioning, vol. 5, 1933, pp. 313-323.
Frederick F. Wangaard, Transverse Heat Conductivity of Wood, ASHVE Journal Section, Heating, Piping & Air Conditioning, vol. 12, 1940, pp. 459-464.
J. D. MacLean, Thermal Conductivity of Wood, ASHVE Journal Section, Heating, Piping & Air Conditioning, vol. 13, 1941, pp. 380-391.
F. F. Wangaard, The Effect of Wood Structure Upon Heat Conductivity, ASME Transactions, 65 (2) 127-135, February 1943.

CITES REASONS FOR PLANNED CONDITIONING

C. Robert Cheney, addressing building owners and managers in an article on planned air conditioning for office buildings in the February issue of the magazine Skyscraper Management, said that—regardless of the extent of air conditioning contemplated either now or in the future—it should be *planned*.

Careful planning by "a competent consulting engineer" is necessary, he stated, so that:

1) You will obtain the air conditioning results you require.

2) Electric service in transformer and switching capacity will be available.

3) Electric wiring of ample capacity and adequate distribution will be available at the points required.

4) Water and drain pipes of ample capacity will be accessible.

5) Maintenance of equipment will be in accordance with a definite, prescribed plan.

6) The entire development of air conditioning within your building will be systematically planned, regardless of the type of equipment or system used and regardless of who pays for the equipment.

QUESTION of the MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication. You are also invited to submit answers to questions from others, which are paid for at regular rates

How to Heat Office Room in Steam Heated Garage

THERE WAS PUBLISHED in the January HPAC a question from "W. O." regarding heating an office room in a garage by means of a hot water radiator, the hot water to be supplied from a steam boiler kept at constant temperature by an aquastat. "W. O." asked if there was anything wrong with his layout, and also what kind of pump to use. Following are some of the answers which have been submitted to this question.

SUGGESTS INSTALLING HOT WATER CONVERTER

Although the scheme submitted by "W. O." and indicated in his sketch will operate, we believe that the system as such, aside from causing possible trouble, will be expensive from the standpoint of power costs for operating the circulating pump against a pressure of approximately 25 ft due to the static head in addition to the friction head.

It is our recommendation that instead of circulating boiler water for the office hot water radiator, it would be more flexible and at the same time less costly in operation to install a below-the-water line type of hot water converter. This can be something similar to an indirect hot water heater, connected below the water line of the oil fired steam boiler and the water circulated through a closed system to the radiator in the office, using a small motor driven circulating pump.

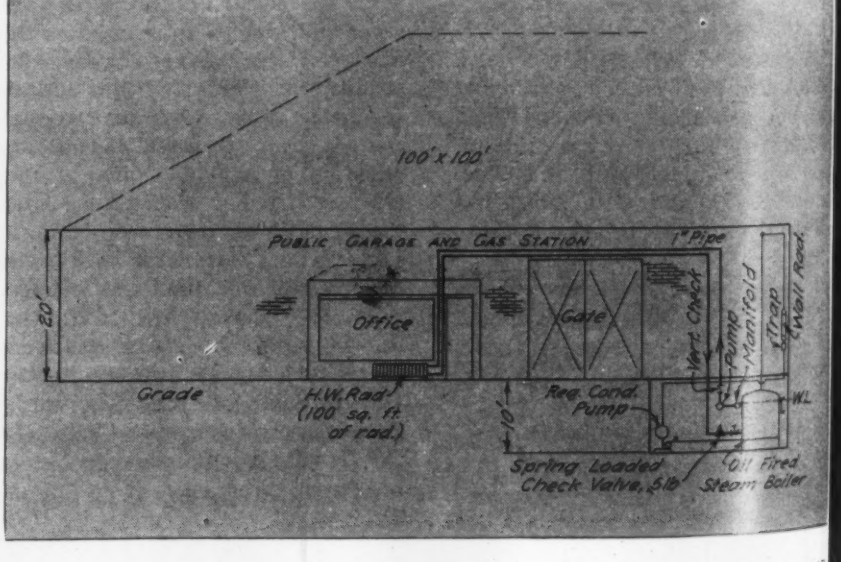
The circulating pump can be controlled from a line voltage type room thermostat in the office which will turn the pump on when heat is required in the office.

The boiler water temperature can be maintained at, say, 180 F at all times during the period when heating is required in the office by an immersion type aquastat wired to the burner.

A water make-up line together with a water pressure regulator and relief valve should be installed in the water circulating circuit to the radiator.

In regard to the circulating pump this can be a pump especially designed for this type of service, of which there are many manufactur-

"W.O." asked if there was anything wrong with this proposed layout for heating an office in a garage



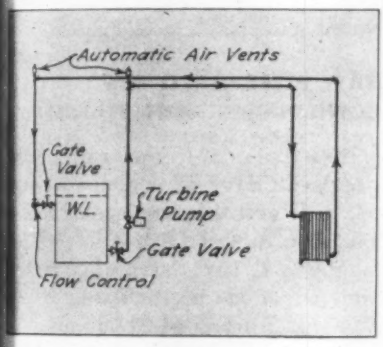
ers. The pump should have a capacity of approximately 4 gpm based on circulating 180 F water with a 10 F temperature drop through the radiator.

If 1 in. pipe is used, and assuming the total equivalent run including pipes and fittings does not exceed 100 ft, then the pump will be operating against a head of approximately 2 ft of water. If ¾ in. pipe is used for both supply and return, assuming again the same length of run, then the pump will be operating against a head of approximately 5 ft of water.

We hope that the above will be of assistance to "W. O." in solving his problem.—P. N. C.

"WE HAVE SOLVED THE SAME PROBLEM"

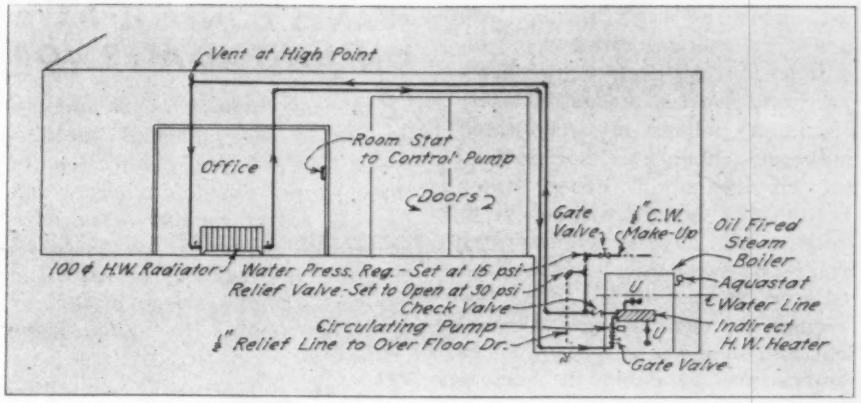
We have solved the same problem as "W. O.'s" by using a small 350 gph turbine pump with a ¼ hp mo-



"A.C.C." has solved the same problem on a job involving two unit heaters using steam to partly heat the repair shop; two radiators and a floor panel using hot water to complete heating of the shop; a floor panel and a unit heater to heat the office and display room using hot water; and a radiator using hot water to heat the parts room

tor. This pump, with a strainer, was installed on the lower boiler connection to draw the water out of the boiler and to push it into the top radiator connection—no special manifold was necessary. An air eliminator was installed at the high point of each line. A flow control valve was installed on the return pipe at the higher point of the boiler and below the waterline.

Our sketch shows this particular phase of our installation which interests "W. O." However, our installation consists of a combination steam-hot water system with two unit heaters using steam to partly heat the repair shop; two radiators and a floor panel using hot water to complete the heating of the shop; a floor panel and a unit heater to heat the office and display room using hot water; and a radiator using hot water to heat the parts room. The job is most satisfactory.—A. C. C.



"P.N.C." suggests using a hot water converter

HELPFUL COMMENTS ON ARRANGEMENT GIVEN

"W. O." indicates an intelligent approach to his garage office heating problem. Certain suggestions, however, might be helpful in final arrangement of the system.

Apparently the steam boiler now operates intermittently with a manually controlled burner and automatic water level control. For some reason steam service is to be retained for heating the garage proper, instead of increasing the coil surface and converting the entire job into a hot water type system with a circulator responsive to selected thermal demands and a manual valve in the garage by which to interrupt the heat supply to coils while the large doors are open.

Dividing the boiler functions, as described by "W. O.", does introduce the problem of preserving proper boiler water level while maintaining intermittent flow to the office radiator. Also, water hot enough to steam in the boiler would be too hot for a small office and ordinary size radiator. If the radiator size were reduced, one could still expect frequent cycling of pump operation.

However, for the arrangement indicated by "W. O.," the pump could be of the type employed as circulators in forced hot water heating systems. A stop valve and union preceding the pump and a union and stop valve following the check valve would facilitate inspection and repair of the pump and check valve, without draining the office radiator piping or introducing much air. Similar precaution would apply to the weighted check valve in the radiator return.

The radiator supply should be tapped into the boiler below the minimum water level to maintain an assured water seal, particularly when the pump is working. Any steam made in the piping would be readily condensed in the riser. Ample manifold and connections would minimize flash steam in the pump suction if for some reason the pump location cannot be depressed.

Air and water present a corrosive combination in the piping. Moreover, air gathered in a pocket might bind the system or otherwise interfere with desired operation. The air could be purged from the system through a float vent connected above the high point. A vacuum vent or check valve on the float vent air discharge would prevent re-entrance of air into the system. However, a stop valve connected into the float vent riser would provide ready means for admitting air when draining the system.

Ordinarily, one would expect to see the pump located in the return line, where it would be less subject to binding, either at the radiator (in this case) or near the boiler. Here, again, the vertical check valve shown in the radiator supply line could well be replaced with a horizontal swing type just outside of the stop valve recommended at the manifold and properly weighted, and boiler steam pressure should be kept above zero gage.

Probably the most practical way to heat the radiator water would include an indirect heater. Such heaters are mounted alongside their associated boilers and connected thereto in a manner promoting thermal circulation of boiler water through the heater without jeopardizing the desired boiler water level. The mechanically circulated radiator water would thus flow through its own system, independent of boiler water content. The heaters are available in various sizes, one or more of which would be appropriate for the described radiator and piping heat demand and boiler water temperature. Proper selection of heater would also help to minimize the frequency of starting and stopping the pump.

In either arrangement discussed, automatic control of burner operation would promote satisfactory service of the entire installation. If steam is employed for garage coils described, a pressure-stat should be employed for burner control and a valve or valves should be conveniently located and employed for interrupting and restoring the heating service from coils. Such an arrangement would reduce thermal stresses in the boiler and connections thereto; promote longer service life of the installation; improve performance of the entire system; and would be much more convenient and safer than running down cellar every time the large doors are operated to stop or start the burner.

If the heating system were converted to hot water type throughout, an aquastat controlling boiler water temperature by burner operation would accomplish a similar purpose. The foregoing discussion illustrates the flexibility of heating systems and shows there may be several ways to obtain somewhat similar results. The safest and most positive way is usually the best.—R. A. S.

"SIMPLE, ECONOMICAL, EFFICIENT" PLAN

Assuming that the oil burner is automatically controlled for keeping a certain pressure in the boiler, I submit a simple, foolproof solution to "W. O.'s" problem.

When steam is not required in the shop but is in the office, the main line shutoff can be closed, permitting the boiler and burner to operate in the regular manner.

Purpose of the header trap is to keep the riser clear of condensate when the automatic radiator valve is closed. Placing the radiator trap in the position indicated in my sketch will also give more efficient operation, although if the trap were placed at the radiator with the return below it, water hammer could be eliminated. This will occur more often in milder weather when the radiator is shut off for longer periods of time.

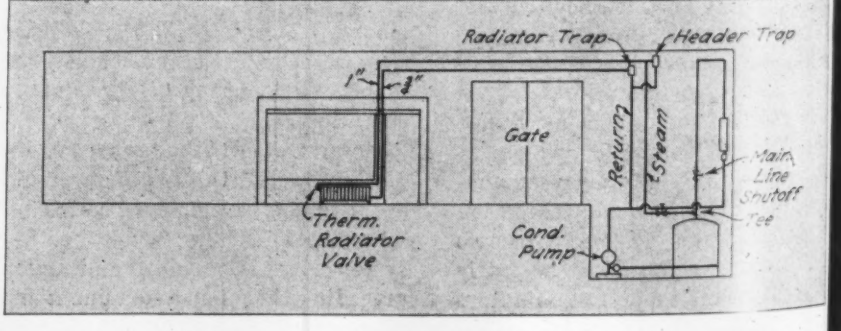
Of course, the radiator trap should be large enough to allow for heat lost in transmission.—M. A. M.

WANTS CONTROL DATA ON UNIT HEATER JOB

YOU ARE *invited to submit an answer to the following question from "J. B." for publication in these pages. Suitable answers will be paid for at regular rates, with additional payment for sketches. You are invited, too, to submit a question about heating, piping, or air conditioning for publication.*

THE USUAL METHOD of controlling a steam unit heater is to have the fan on or off according to the demands of a thermostat located in the area heated. When the fan is off, however, with steam pressure in the heater, a fair amount of heat is still emitted from the unit—so on some jobs there is a valve in the supply line to the unit to turn the steam as well as the fan on and off. I would be interested in any information on the relative advantages and disadvantages of this more elaborate and therefore more expensive method of control on unit heater installations.—J.B.

"M.A.M." suggests this scheme, says it is "simple, economical, and efficient"



BUILDING RESEARCH BOARD TO BE SET UP

John C. Stevens, chairman of the construction industry advisory council of the Chamber of Commerce of the United States, announced last month that the National Research Council has agreed to set up a building construction research board to serve as a clearing house of technical research information in the field of building construction.

Principal function of the new board will be to collect and disseminate technical research information of importance to the building industry. It will also provide "a meeting place at which those actively engaged in research activities will be able to exchange ideas, and a mechanism for the correlation of activities carried on simultaneously by several organizations." No direct laboratory activity is contemplated.

DATE POSTPONED FOR CONDENSING UNIT STANDARD

Effective date for commercial standard CS107-45, commercial electric refrigeration condensing units, has been moved from February 20 to May 20, 1947, according to the division of trade standards of the National Bureau of Standards.

Following announcement of the February date, urgent requests were received from several manufacturers producing a substantial volume of the units for reconsideration of the effective date, to allow time for formulation of a revision clarifying the intent of the standard in the light of postwar industry developments. It is understood that action toward such revision as may be indicated is to be taken in the very near future.

DATA SHEET

Conductivities and Conductances of Building Materials and Insulations

By Paul D. Close

TABLE 5—CONDUCTIVITIES (*k*) AND CONDUCTANCES (*C*) OF PLASTERING AND ROOFING MATERIALS

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference. Conductivities (k) are per 1 in. thickness. Conductances (C) are for thickness or construction stated

MATERIAL OR DESCRIPTION	DENSITY (lb per cu ft)	MEAN TEMP. (F)	CONDUCTIVITY (*k*)	CONDUCTANCE (*C*)	RESISTANCE (*R*)*	AUTHORITY OR REFERENCE
Asbestos shingles	65	75		6.0	0.17	(3)
Asphalt roofing, composition or prepared	70	75		6.5	0.15	(3)
Asphalt shingles	70	75		6.5	0.15	(3)
Built-up roofing, gravel or slag surface			1.33		0.75	(2)
Insulating plaster 0.9 in. thick applied to $\frac{3}{8}$ in. gypsum board	54.0	75		1.07	0.93	(3)
Plaster, cement			8.0		0.13	(2)
Plaster, gypsum, $\frac{3}{8}$ in. thick		73		8.8	0.11	(3)
Plaster, gypsum and expanded vermiculite, 4 to 1 mix	39.9	75	0.85		1.18	(3)
Slate			10.0		0.10	
Wood lath and plaster, total thickness $\frac{3}{4}$ in.		70		2.5	0.4	(1)
Wood shingles				1.28	0.78	

*The resistances in this column are for 1 in. if the conductivity (*k*) is given or for the thickness or construction stated if the conductance (*C*) is given.

TABLE 6—CONDUCTIVITIES (*k*) OF NON-INSULATING WALLBOARDS AND BUILDING BOARDS

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference per inch thickness

MATERIAL OR TRADE NAME	DESCRIPTION	DENSITY (lb per cu ft)	MEAN TEMP. (F)	CONDUCTIVITY (*k*)	RESISTANCE (*R*)	AUTHORITY OR REFERENCE
Asbestos mill board	Compressed	60.5	86	0.84	1.19	(3)
Cement asbestos board	Compressed cement and asbestos sheets	123	86	2.70	0.37	(1)
Corrugated asbestos board		20.4	110	0.48	2.08	(2)
Gypsum board	Gypsum between layers of heavy paper	62.8	70	1.41	0.71	(3)
Presdwood (plain)	Hardboard made from exploded wood fibers, $\frac{1}{8}$ in. to 5/16 in. thick			1.40	0.72	(3)
Presdwood (tempered)	Hardboard made from exploded wood fibers, $\frac{1}{8}$ in. to 5/16 in. thick			1.50	0.67	(3)
Wall pulp board	Stiff pasteboard	43	86	0.494	2.03	(1)

TABLE 7—CONDUCTIVITIES (*k*) OF INSULATING BOARDS

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference per inch thickness

MATERIAL OR TRADE NAME	DESCRIPTION	DENSITY (lb per cu ft)	MEAN TEMP. (F)	CONDUCTIVITY (*k*)	RESISTANCE (*R*)	AUTHORITY OR REFERENCE
Celotex	Cane fiber insulating board	13.5	70	0.33	3.03	(1)
Celotex	Cane fiber insulating board	13.2	86	0.34	2.94	(1)
Celotex	Cane fiber insulating board	14.8	86	0.34	2.94	(1)
Homasote	Insulating board made from newsprint and vegetable fibers	25.0	75	0.375	2.66	(1)
Insulite	Wood fiber insulating board	16.0	70	0.33	3.03	(1)
Insulite	Wood fiber insulating board	16.2	86	0.34	2.94	(1)
Insulite	Wood fiber insulating board	16.9	86	0.34	2.94	(1)
Maizewood	Insulating board made from cornstalks	15.0	71	0.33	3.03	(1)
Masonite	Wood fiber insulating board	15.0	75	0.33	3.03	(1)
Nu-Wood	Wood fiber insulating board	15.0	72	0.33	3.03	(1)
Temlok	Wood fiber insulating board	15.0	70	0.33	3.03	(2)
Weatherwood	Wood fiber insulating board	15.2	70	0.33	3.03	(1)
	Plain insulating board without finish	16.9		0.35	2.86	(1)
	Plain insulating board without finish	16.2		0.34	2.94	(1)
	Plain insulating board without finish	16.9		0.36	2.78	(1)
	Plain insulating board without finish	16.6		0.34	2.94	(1)
	Plain insulating board without finish	19.5		0.37	2.71	(1)
	Plain insulating board without finish	15.7		0.37	2.71	(1)
	Plain insulating board without finish	16.5		0.33	3.03	(1)
	Plain insulating board without finish	17.0		0.33	3.03	(1)
	Plain insulating board without finish	18.2		0.36	2.78	(1)
	Plain insulating board without finish	16.5		0.37	2.71	(1)
	Plain insulating board without finish	21.8		0.40	2.50	(1)
	Interior finish insulating board	21.0		0.39	2.57	(1)
	Interior finish insulating board	16.9		0.36	2.78	(1)
	Interior finish insulating board	20.7		0.35	2.86	(1)
	Interior finish insulating board	18.3		0.36	2.78	(1)
	Insulating board sheathing	20.0		0.39	2.57	(1)
	Insulating board sheathing	17.0		0.38	2.64	(1)
	Wood fiber insulating board	15.5	—60	0.285	3.51	(4)
	Wood fiber insulating board	15.5	—30	0.297	3.37	(4)
	Wood fiber insulating board	15.5	0	0.310	3.22	(4)
	Wood fiber insulating board	15.5	30	0.323	3.10	(4)
	Wood fiber insulating board	15.5	60	0.335	2.99	(4)
	Wood fiber insulating board	15.5	90	0.348	2.87	(4)
	Wood fiber insulating board	16.2	75	0.343	2.92	(4)
	Wood fiber insulating board	16.99	74.9	0.373	2.68	(4)

References—see last column of tables:

(1) United States Bureau of Standards. (2) Tests conducted at University of Illinois by A. C. Willard, L. A. Harding, L. C. Lichty and others. (3) Tests conducted at Illinois Institute of Technology (Armour Research Foundation), by J. C. Peebles. (4) Tests conducted at University of Minnesota, by F. B. Rowley, et al. (5) American Society of Heating and Ventilating Engineers Research Laboratory. (6) Tests conducted at Pennsylvania State College by Hechler and Queer. (M) Data from manufacturer; authority not stated.

CONDUCTIVITY AND conductance values have been compiled by the author from published sources and are given in Tables 1 to 11 inclusive. It will be noted that the values in Tables 1, 3, 6, 7, 8, 9, 10 and 11 are conductivities (*k*) and are therefore based on a 1 in. thickness of the material reported in each case. Tables 2 and 4 are conductances (*C*) and are for thicknesses other than 1 in. or for combinations of two or more materials. Table 5 contains both conductivity and conductance values. All coefficients express the rate of heat transfer between the material surfaces in Btu per hr per sq ft per deg Fahrenheit temperature difference per inch thickness (where the conductivity is given) or for some other thickness or combination of materials (where the conductance is given). Resistances (*R*) or resistivities, which are the reciprocals of the conductances or conductivities, are also listed, as well as the authorities in each case.

The tests were conducted by generally reliable sources. There is no certainty, however, that the figures for proprietary materials correspond with those for similar materials purchased in the open market. These and other pertinent facts should be considered when using these data.

Tables 1 and 2 were published in January, and Tables 3 and 4 in February. Tables 5, 6, and 7 appear this month, and the others will follow.

[Note: Mr. Close is technical advisor for Simpson Industries, Inc., sales division of the Simpson Logging Co. He was formerly technical secretary of the Insulation Board Institute, and before that was technical secretary of the American Society of Heating and Ventilating Engineers.]

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Minimal Replenishment Air Required for Living Spaces

Under Conditions of Mechanical Cooling and in Conjunction with the Removal of Odors by Activated Carbon and Other Means†

By William V. Consolazio* and Louis J. Pecora**, Bethesda, Md.

SUMMARY — The essential problem in this investigation was to ascertain the minimal quantity of replenishment air required in a simulated ship's berthing space to keep odors at an acceptable level in conjunction with air cooling. Furthermore, activated carbon, ozone, and a liquid deodorizer were evaluated as means of controlling odors. With activated carbon the replenishment air necessary for maintenance of an acceptable odor condition can be reduced considerably below 5 cfm per man. Ozone and the liquid chemical deodorant employed in separate tests did not reduce the odor level. Exposure to these substances, however, after a period of 10 min apparently exerted an anesthetic effect relative to odor perception.

Introduction

In enclosed living spaces air conditioning simultaneously controls temperature, moisture content, movement and quality of the air (1)[1]. In regard to air quality, it is generally accepted that when humans are the only source of contamination the minimal quantity of outdoor air needed is that required to remove objectionable body odors and tobacco smoke. Under certain conditions factors such as oxygen and carbon dioxide concentration, bacterial content and dust pollution also need to be considered. Since weight, space and cost of installation and operation are critical factors aboard ships, replenishment air for berthing spaces must be minimal if air conditioning is to become practical.

The basic problem considered in this report therefore is the determination of the minimum quantity of outdoor replenishment air necessary to keep odors in ships' berthing compartments within acceptable limits. The odor level in any space depends upon a number of factors including structural characteristics of the environment, dietary and hygienic habits of the occupants, amount of outdoor air supplied, concentrations of tobacco smoke, the space allowed per person, capacity and temperature of the wet coil cooling surface, and the temperature and relative humidity of compartment and weather air.

In the experiments to be described, a moderately air tight compartment was utilized and considerable care was exercised to reproduce the extreme conditions ordinarily encountered in berthing spaces.

Experimental Design and Procedures

Three groups of experiments were undertaken as shown in Table 1. The first group (experiments 1-4) were designed to standardize operations, (*a*) to indoctrinate the judges in odor perception, (*b*) to develop chemical or physical methods of odor determi-

† The material in this article should be construed only as the personal opinions of the writers and not as representing the opinion of the Navy Department officially.

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** Naval Medical Research Institute, National Naval Medical Center.

[1] Numerals in parentheses refer to References at end of paper.

Presented at the 53rd Annual Meeting of the American Society of Heating and Ventilating Engineers, Cleveland, Ohio, January 1947.

nation, (*c*) to systematize the sampling of air for dust, bacteria and gases and (*d*) to establish a routine for the subjects. The second group (experiments 5, 6, 7, 12, 14, 15) was carried out under conditions of air cooling usually at 78 deg E T (85 F dry bulb—72 F wet bulb) at approximately 15, 10, 5 and 1 cfm replenishment air per man when the outside air was relatively warm and moist. At 53 cfm per man (experiment 9) mechanical ventilation was employed without cooling and the average campartment effective temperature rose to 81 deg (87 F dry bulb—76 F wet bulb). The third group (experiments 8, 10, 11, 13, 16, 17, 18, 19, 20, 21, 22) was designed to study the mechanics of odor development and control, (*a*) to determine the efficacy of activated carbon and other agents designed to remove substances giving rise to odors, (*b*) to compare odor levels at various effective temperatures and (*c*) to study the effects of smoking and non-smoking on the quality of the chamber air. Experiments 16-22 were performed during cold weather when the heating of the air supply precluded condensation on cooling coil surfaces.

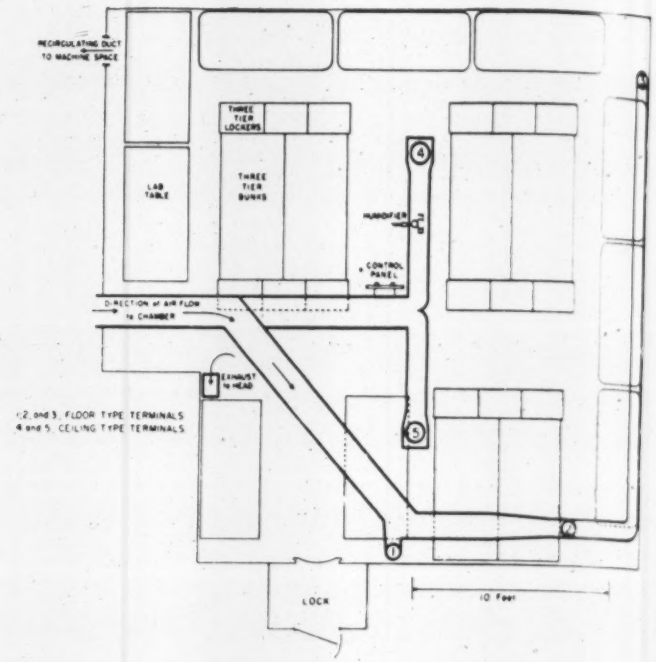

Fig. 1—Layout of experimental compartment. Replenishment air was drawn into the recirculating duct as it entered the machine space by way of a *T* cut into this duct just aft of the compartment partition. This air then proceeded over heating units, through the fan, and then over the cooling coils whereupon it entered the compartment where the excess was exhausted into the toilet below

The Test Compartment: The dimensions of the test compartment were approximately 26 ft in length, 25 ft in width and 10 ft in height (Fig. 1). The gross air volume was 6500 cu ft and the floor area approximately 650 sq ft. The floor, ceiling, and walls were constructed of sheet steel with all joints lapped. An air lock was provided to minimize the effects of traffic to and from the chamber. The compartment and its air conditioning machinery was more airtight than a corresponding commercial installation. The space contained 45 bunks, lockers, and other accessories necessary for living purposes and accommodated 45 men who constantly occupied the compartment. The gross space per man was approximately 140 cu ft which included the space occupied by furnishings.

Toilet facilities were in a separate compartment beneath the berthing space and served the occupants of the experimental compartment. Its dimensions were approximately 13 ft in length, 11 ft in width and 10 ft in height; the air space was approximately 1500 cu ft. It contained two toilets, one urinal, two wash stands, and one hopper. Shower facilities were available in an adjacent building.

Air Supply to Compartment: Mechanical supply and exhaust were provided so that each occupant could be supplied with as much as 53 cfm. In addition, heating and cooling coils were available and provision was made for the recirculation of air and for the intake of measured quantities of outdoor air.

Two Navy Standard duct cooling coils (plate fin type) 12 x 30 in. with a face area of approximately 2.5 sq ft were used when air cooling was employed. Whenever there was use for the cooling coils the surface tempera-

Table 1—Experimental conditions in regard to duration of experiments, dry and wet bulb temperatures, and replenishment air quantities.

Experiment No.	Duration (hours)	Weather air		Compartment air		Replenishment air cfm/man	Remarks
		DB F	WB F	DB F	WB F		
1	144	—	—	86	73	15	78 deg ET
2	408	77.3	69.4	85	71	5	78 deg ET
3	120	81.0	73.6	85	72	5	78 deg ET
4	192	80.9	74.4	85	73	1	78 deg ET
5	192	78.7	69.9	86	73	15	78 deg ET
6	152	75.8	68.2	85	72	10	78 deg ET
7	192	75.6	67.4	86	71	5	78 deg ET
8	124	73.6	69.3	81	75	5	Same Effective Temp. WB and DB changed
9	124	72.8	68.1	87	76	53	81 deg ET Mechanical ventilation
10	105	67.5	64.2	86	71	5	78 deg ET No smoking
11	105	76.9	73.0	86	71	5	78 deg ET Ozone—Liquid Deodorizer
12	75	57.8	53.1	86	70	1	78 deg ET
13	105	58.5	53.6	89	74	1	82 deg ET
14	105	58.7	55.2	85	72	1	78 deg ET
15	105	64.3	58.3	85	72	1	78 deg ET
16	80	50.3	45.5	86	71	1	Conservation of air (carbon) 2250 cfm
17	96	50.2	44.7	85	71	1	Conservation of air (carbon) 2250 cfm
18	72	44.2	40.7	86	71	1	Conservation of air (carbon) 1100 cfm
19	72	37.0	32.8	84	69	1	Conservation of air (carbon) 550 cfm
20	48	47.5	46.0	86	71	1	No carbon
21	72	36.3	33.2	85	70	1	No carbon
22	120	39.6	36.5	84	67	1	No carbon, no occupants

tures were maintained between 40 and 55 F. Throughout the 22 experiments an attempt was made to keep the total air circulated over the coil surface as nearly constant as possible (approximately 2500 cfm). The ventilation practice of exhausting a berthing compartment through a duct into the toilet facility and then outboard was followed.

The replenishment air was introduced by means of a *T* cut into the recirculation duct; the intake consisted of a calibrated 12-in. diameter flow nozzle (coefficient =0.99). All air flow measurements, including replenishment air, were made by a modification of King's linear hot wire anemometer (2). The instrument employed was basically a wheatstone bridge, one arm of which consisted of a rigidly mounted section of 0.05 mm platinum wire approximately 1 in. long. This instrument was calibrated and supplied by the Material Laboratory, New York Naval Shipyard.

Replenishment air quantities were measured at the beginning, several times during the course, and at the end of each experiment. Whenever the volume of replenishment air was changed, a complete air balance check was made of the over-all air distribution which included recirculated air, replenishment air and exhaust air from the compartment.

Temperature, Humidity and Air Movement: A 78 deg E T (85 F dry bulb—72 F wet bulb) with an average air movement of approximately 30 fpm was maintained throughout most of the experiments. Exceptions were made in several experiments where odor levels were studied in relation to changes of temperature and humidity.

Water Vapor Content of Replenishment Air: The compartment temperatures were rigidly maintained by wet and dry bulb control devices of the conditioning machinery. In experiments conducted in the fall and winter of the year, the outside air had to be preheated before being brought into the compartment. During the cold periods refrigeration was still supplied to the cooling coils to maintain the desired wet bulb conditions and also as a control on earlier experiments.

Compartment Routine: Experiments were of from 2 to 17 days duration. Before a new experiment was begun or whenever the replenishment air conditions were altered, all bed linens, mattresses and mattress covers were aired for at least 24 hours and the compartment, including ducts, coils, walls, and floors, was thoroughly scrubbed. Discipline was maintained whenever it was essential to the experiment to keep the compartment fully occupied and the surroundings clean. The compartment was swept twice daily and floors were washed once daily.

All soiled clothes, especially those used for work or athletics, were laundered only at a scheduled time. Subjects were allowed to change their underclothes as often as they desired but they were required to stow soiled clothing in lockers within the compartment in order to conform to conditions expected aboard naval ships.

Routine of Occupants: A total of 75 young men (18 to 22 years) served as subjects. Of these, 45 men were in the compartment at all times. Each man spent approximately 20 hours daily in the compartment and four hours exercising outdoors. Exercise consisted of work or athletics sufficient in amount to produce sweating. A shower bath was required following exercise and before re-entering the compartment, which amounts to one shower per person per one and a half days. General toilet such as washing the face and hands and brushing the teeth was permitted early in the morning and after the evening meal. The men were free to visit the toilet facilities whenever they desired. Food was eaten at the regular mess in an adjacent building. With respect to diet, exercise, bathing and cleaning of clothes, the routine was similar to that aboard naval ships. Whenever occupants left the compartment to participate in group activities, stand-by personnel took their place. Smoking was permitted throughout all experiments except on studies concerned with body odors.

A wide variation in habits of cleanliness and personal hygiene was noted among the subjects.

Estimate of Odor Levels: Although odor level is the critical determination in these experiments, there is no quantitative method available for recording it. It was necessary, therefore, to train men to judge degrees of odor on the bases outlined by Lehmberg et al (3) and Yaglou et al (4), modified to fit the conditions of the experiments. Sixteen trained men were employed to judge odors. The majority were smokers.

Scale of Odor Impressions

		Primary	Residual
No Odor	0.0	☐	☐
	0.5	☐	☐
Threshold Odor, Just Barely Preceptible	1.0	☐	☐
	1.5	☐	☐
Definite Odor, But Not Objectionable	2.0	☐	☐
	2.5	☐	☐
(If I had the choice of theaters where all conditions other than this odor were the same, the odor would not prevent me from patronizing it.)			
Strong Objectionable Odor	3.0	☐	☐
	3.5	☐	☐
(This odor is strong and sufficiently objectionable to prevent me from attending the theater in which it is present unless there were some sufficiently compensatory feature, *e.g.*, an excellent play.)			
An Odor Very Strong and Disagreeable, Yet Tolerable	4.0	☐	☐
	4.5	☐	☐
(I would object strenuously to this odor in any place of occupation, yet it would not prevent me from working there if I knew it to be noninjurious.)			
An Overpowering, Unbearable and Nauseating Odor	5.0	☐	☐

Instructions

1. Do not smoke for 20 min before entering the compartment.
2. Breathe deeply of fresh odor-free air for a few minutes before entering a test compartment, then enter quickly and with a few quick sniffs, decide upon and record the Primary Odor Impression. After one minute again take a few quick sniffs and record the Residual Odor Impression.
3. Be certain that the Scale Value which you check as your Primary Odor Impression is the impression which you would receive if every sniff over the period of a working day were to be exactly as effective as the first one taken upon entering the compartment, i.e., avoid olfactory fatigue.
4. Keep thoroughly familiar with this Scale.

In judging the quality of air, two odor impressions were made; the first (primary) was recorded immediately upon entrance into the compartment, the second (residual) was recorded following exposure of the judge to the environment for one minute. An attempt was made at identification of the odor or odors prevalent. The use of hair tonics, oranges, shoe polish, and other odoriferous substances interfering with odor perception was forbidden in the compartment.

The two odor impressions were obtained to satisfy the demands of the designing engineer. The question frequently asked is, for whom is the system being designed? If the system were being designed for the transient, then one set of conditions obtains; if it were being designed for the occupant, then another set obtains. In order to answer these questions the primary impressions were obtained to gain the necessary information pertaining to the transient, whereas the residual impressions were obtained to gain similar information for the occupant. It is realized that the exposure of 1 min is not of sufficient duration to warrant such a conclusion. However, the error is in the right direction and the conditions favor the occupant.

The scale used to record odor impressions is shown on p. 105. Division is in half units since experience showed that the trained judge could determine the odor level to within half a unit. The judges were at no time conscious of the actual experimental manipulations except in cases where the conditions were so obvious that the fact could not be hidden; for example, in the employment of carbon sorption units.

It is to be emphasized that although a scale of odor impressions was employed, the basis for the differences recorded in the odor impressions were qualitative and not quantitative. Thus, a disagreeable but faint odor might be scored 3.0, whereas a strong but less offensive odor such as tobacco smoke might be scored 2.0. This concept of odor perception is in contrast to that of Yaglou in which odor intensity is stated to be in accord with the Weber-Fechner law of physiological reactions, namely, sensation $= K$ log of stimulus. K varies with the type of odor encountered when the odor is not complicated by other odors. Combinations of odors completely nullify the application of this law and since in spaces occupied by humans one usually encounters more than one type of odor, application of this law is questionable.

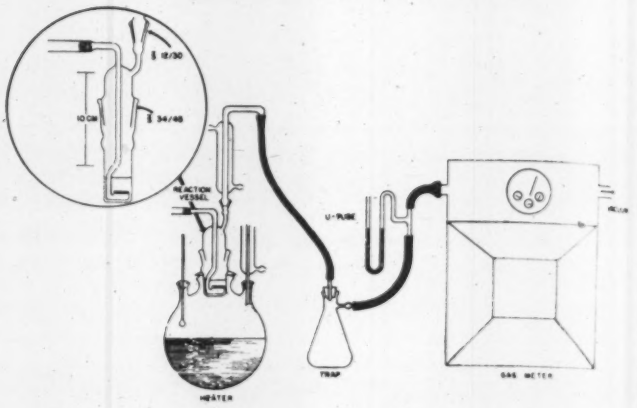

Fig. 2—Apparatus used for the chemical estimation of reducing substances in air

Consequently, the chief distinction made in these experiments was to determine whether or not the prevailing odor or odors within the compartments were objectionable or acceptable.

Chemical Method for the Determination of Odoriferous Substances: Since perception of odors is purely qualitative and is further limited by the fact that any quantitative basis, if it exists, rests on a logarithmic relationship of stimulus (odoriferous substances present) to sensation, an attempt was made to develop a chemical[2] method of analysis using an acid-permanganate solution ($KMnO_4$) to oxidize organic matter in the air. The method employed was based on a similar method described by Lang, et al (5).

A given volume of air was drawn at a definite rate through a small heated reaction vessel (Fig. 2) containing a dilute solution of acid-permanganate. After cooling and making this solution up to its original volume, the per cent transmission of the solution was determined and compared with the absorption of solutions of permanganate of known normality. The volume of air drawn through the scrubber was measured by means of a reinforced dry gas meter; an open U-tube mercury manometer was used to determine the pressure within the system. The flow was carefully regulated to allow 33 liters (1.165 cu ft) of air to pass through the scrubber in 20 min.

From a survey of the oxidation of various odoriferous compounds such as alcohols, aldehydes, ketones, ethers, esters, amines, mercaptans, and inorganic sulfides by acid-permanganate without drastically splitting the molecule, it was calculated that the number of atoms of oxygen required for oxidation of a molecule of the compounds averaged a little less than two. This gives little idea of the weight of the analyzed material suspended in the air since the molecular weights of the compounds being oxidized are unknown. However, by expressing the final results in terms of milliequivalents of reduction of $KMnO_4$ occurring per 1000 cu ft of standard air there is obtained an empirical value which may be used for day-to-day comparisons.

The acid-permanganate solution is not reduced by a large group of strong smelling substances; namely the aliphatic acids, the hydrocarbons, and phenolic substances; however, tobacco smoke gives marked and rapid reduction of the solution.

Bacterial Assay of Air: The medium employed throughout the experiment was a meat infusion agar of the composition suggested by Schneiter, et al (6). All bacterial air sampling was done twice daily (10:30 a.m. and 1:30 p.m.) and at the same location.

Three methods of air sampling were employed.

1. *Petri Plate Method:* Sterile meat infusion agar Petri plates were exposed for

[2] A physical system based on absorption of organic vapors on carbon with subsequent weighing failed to materialize into a reliable method.

Table 2—Air supply and distribution to the compartment

Replenishment air desired (cfm/man)	53	15	10	5	1
Supply air through compartment inlets (cfm)	2362	2910	2358	2800	2319
Replenishment air (cfm)	2362	685	520	225	45
Recirculated air (by difference) (cfm)	—	2225	1838	2575	2274
Recirculated air (measured) (cfm)	—	1990	1730	2683	1965
Error in measurements (cfm)	—	235	108	108	309
Per cent error	—	8.1	4.6	3.9	12.5
Outgoing air at exhaust terminal (cfm)	—	472	297	180	53
Replenishment air (cfm/man)	52.4	15.2	11.5	5.0	1.0
Total air supply (cfm/man)	52.4	64.6	52.6	62.2	53.4

15 min at levels of 15, 62, and 120 in. above the floor and equally spaced about the compartment. The resultant counts were averaged for the daily count.

2. *Impingement Method:* The adjustable funnel device as described by DuBuy, et al, (7) was used. The impingement rate was 25-27 liters (0.88—0.95 cu ft) per minute for a three minute period.

3. *Filtration Method:* The bubbler device as described in (6) and (7) was used. The rate of flow was 5-6 liters (0.18—0.21) cu ft) per minute for a 30-min period. Four plates in triplicate were made from the sample after adjustment of the sample to the original volume with sterile water. The average of the triplicate plates was used for the daily average. For the detection of hemolytic streptococci a duplicate set of pour plates was also made from the sample by the addition of 5 per cent defibrinated rabbit blood to the meat infusion agar.

The measurement of the rates of flow and volume of air samples was made by means of a dry gas meter and flow meter similar to that in Fig. 2. All plates were counted over a Quebec colony counter after 48 hours incubation at 37 C (98.6 F).

Dust Measurements: The Bausch and Lomb dust counter (8) was used throughout all these experiments in the assay of dust. Sampling and assays were done according to directions submitted with the instrument. Examination and counting was done by means of the attached microscope using the counting graticule in the eyepiece. The average particle size was also determined by the use of special lines inscribed on the graticule for that purpose.

The samples were taken in the four corners of the chamber at three levels similar to Petri plate collection of bacteria, and at approximately the same time of day. Thus, it was possible to obtain a series of samples representative of the chamber as a whole.

Gas Sampling and Analysis: Twice daily when air samples were taken for bacterial study, duplicate gas samples were collected for analysis of carbon dioxide and carbon monoxide content. Carbon monoxide analyses were made in the earlier experiments to determine whether or not smoking should be limited.

Sampling and Analysis of Condensate from Cooling Coils: At intervals corresponding to the time at which compartment odor recordings were made, condensate water was collected from the cooling coils of the air conditioning system. The quantity of water was measured, and its odor level was determined along with an identification of the odors present. On two occasions a bacterial examination of the condensate was made.

Employment of Substances to Remove or Mask Odor: A series of experiments was carried out at 78 deg E T to evaluate the efficiency of activated carbon, a liquid deodorizer, and ozone for controlling odors. These experiments were performed late in the fall when little condensate was available from the cooling coils. In some cases, the replenishment air had to be warmed and water vapor added to maintain the conditions required.

1. *Activated carbon* (9): The carbon units employed, contained a total of 80

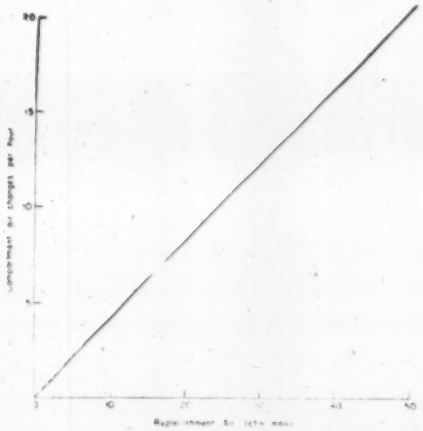

Fig. 3—Relationship between replenishment air and rate of air change in the compartment

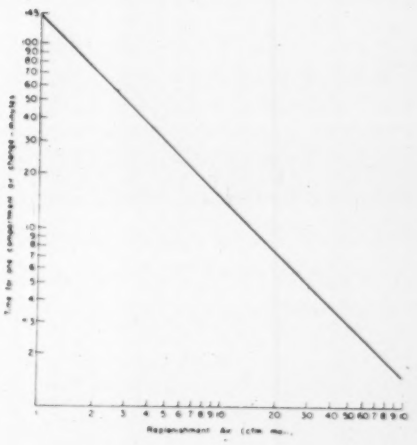

Fig. 4—Relationship between replenishment air and the time for one complete air change in the compartment

canisters made up into four units. These units were laid out back to back in the center of the compartment. The rate of air flow over the carbon bed and the total available carbon was varied under conditions in which smoking was permitted and limited. These experiments were all carried out at a measurable replenishment air of 1 cfm per man. The total reducing substances were measured in these experiments and odor impressions were obtained for the same conditions.

2. *Liquid Deodorant*: A nationally advertised material, which is a suspension containing mainly a mixture of paraformaldehyde and essential oils and which, it is claimed, purifies the air by means of chlorophyll, was used (10, 11). This compound was chosen, since it has the characteristics of many commercially available so-called liquid deodorizers and also because it has been widely exploited for odor control in both civilian institutions and aboard naval vessels.

3. *Ozone*: The ozone used was manufactured by a commercial type of instrument for which, it is claimed, that none of the obnoxious by-products such as oxides of nitrogen are produced (12). The setting of ozone delivery was made according to the manufacturer's recommendations.

In one series of tests the judges were exposed to the liquid deodorizer or to ozone in an adjacent room for a period of ten minutes before making an appraisal of the quality of the compartment air. In another series of tests the judges recorded their odor impressions of the compartment wherein the test substances were being introduced by way of the replenishment air intake. In these tests the odor level of the substances introduced was definitely noticeable at the air terminals in the compartment and just perceptible within the compartment itself.

Experimental Data and Comments

Air Supply to the Compartment

Even though the greatest precautions were taken in making measurements

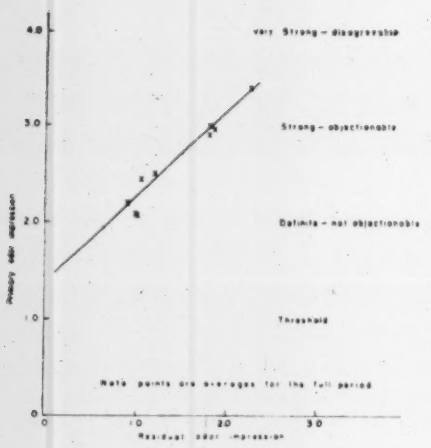

Fig. 5—Relationship between primary and residual odor impressions

of air flow and distribution, considerable difficulty was experienced. Terminal velocities of supply ducts were high and enough encumbrances were in the path of the air stream to produce turbulence. Even though egg-crate louver straighteners were inserted in the return ducts, it was difficult to duplicate the measurements more accurately as shown in Table 2.

From an engineering point of view a ± 15 per cent error is considered permissible in field work. These data show considerably less error than is usually acceptable in tests of commercial installations.

The graph showing the relationship of replenishment air to the compartment air changes per hour is presented in Fig. 3 and is linear as it should be. Since the slope of this curve is related to the volume of the compartment, such a plot is essential in defining the experimental conditions. It is apparent that the dilution of any gas such as carbon dioxide or odors produced in the compartment at a constant rate should theoretically follow a straight line when plotted against replenishment air logarithmic coordinates. Consequently, in defining the compartment conditions the plot, replenishment air against the time for one compartment air change, (Fig. 4), is much to be preferred.

Relation of Odor Level to Replenishment Air Supply

Relationship Between Primary and Residual Odor Impressions: There is good correlation between the two odor impressions (Fig. 5). That some fatigue of the olfactory receptors occurs during the first minute of exposure is shown by the higher level of about 1.2 units recorded for the primary impressions.

Replenishment Air Supply in Relation to Primary Odor Level: At 78 deg ET (85 F dry bulb—72 F wet bulb) a base line could be drawn at an odor level of about 2.0 units (*definite—but not objectionable*) to include values from 10 to 53 cfm of replenishment air per man (Fig. 6). Actually the odor level with mechanical ventilation wherein as much as 53 cfm per man was introduced was of the same order of magnitude as the odor level with air cooling at a replenishment air supply of only 5 cfm per man. The odors responsible for the level of the base line (approximately 2.0 units) emanated from bedding, mattress covers and other material in the compartment.

Upon reduction of replenishment air volume to measurable flows as low as 1 cfm per man, the score for the primary odor impression increased arithmetically from 2.1 to 3.0 as the air supply decreased logarithmically. At 1 cfm per man, the majority of the points plotted just reach the objectionable level (3.0); the other points indicate a higher level.

On the same chart, Fig. 6, are plotted the data of Yaglou for simple ventilation, surface cooler, and spray dehumidification (4). In Yaglou's experiments, the available space per man was approximately double and the recirculated air approximately one-half that used in these experiments. From Yaglou's data (surface cooler) it is obvious that the compartment he employed must have been relatively free from furnishings, since the odor level at the higher replenishment air volumes approaches the threshold level (1.0) and his plot follows a straight line for approximately the same replenishment air volumes used in these experiments. In fact the compartment he employed was practically free from furnishings (13). Both plots show the same score for 10 cfm per man; otherwise the two plots are dissimilar. The odor levels recorded in the author's experiments were considerably lower; in fact, our values for 1 cfm per man correspond fairly well with Yaglou's values for 3 cfm per man. It is to be borne in mind that the authors' experiments for the most part extended over a period of days while those of Yaglou were only of several hours' duration, and that the experimental compartment was fully furnished and contained materials that were continuously emanating odors (fireproof mattress covers) as well as those that had high odor absorption characteristics, such as bedding. Another point of difference is that in the authors' experiments smoking was not limited and it may be that smoking had a masking effect on the type of odors that

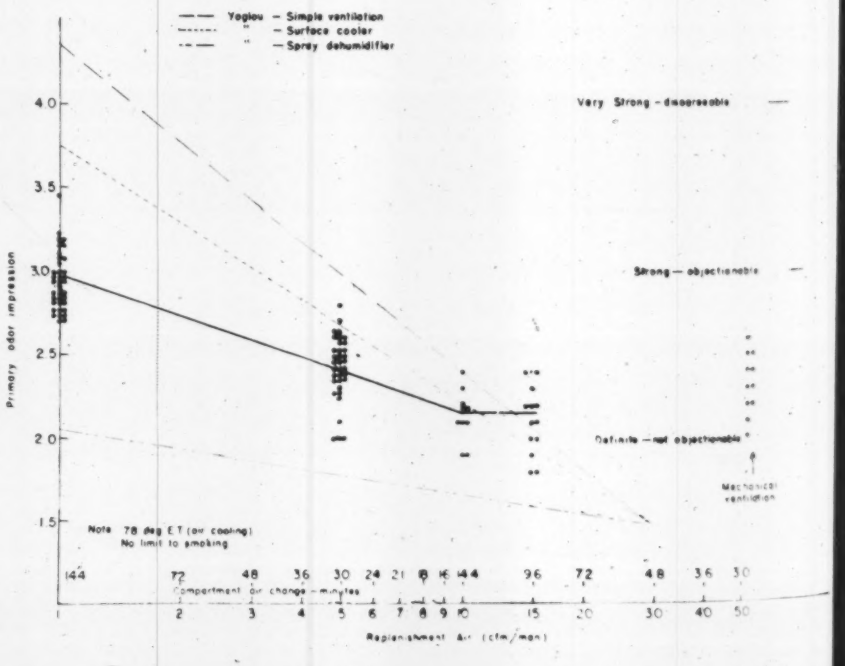

Fig. 6—Relationship of odor levels (primary impression) to replenishment air supply

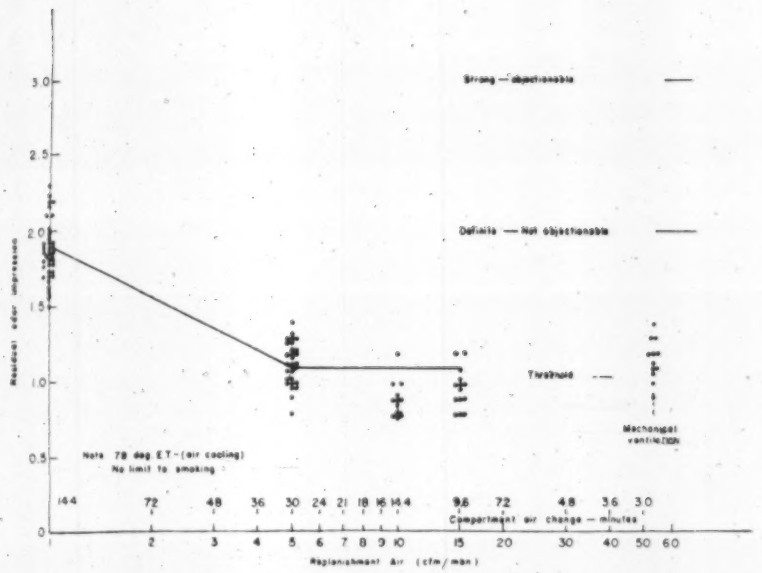
Strong — objectionable
Definite — Not objectionable
Residual odor impression
Threshold
Mechanical ventilation
Note 78 deg E.T.-(air cooling)
No limit to smoking
144 72 48 36 30 24 21 18 16 14.4 9.6 7.2 4.8 3.6 3.0
Compartment air change — minutes
2 3 4 5 6 7 8 9 10 15 20 30 40 50 60
Replenishment Air (cfm/man)

Fig. 7—Relationship of odor levels (residual impressions) to replenishment air supply

are more objectionable. Furthermore, since these experiments were performed during the summer months considerable odoriferous matter may have been removed by condensation on the cooling coils and subsequently carried off along with the condensed water vapor. The compartment wet and dry bulb temperatures in Yaglou's experiments were always maintained at the comfort level and the weather conditions spread over the summer and winter seasons (13).

Replenishment Air Supply in Relation to Residual Odor Level: For the same effective temperature a similar type of curve is obtained as was the case in the primary odor levels. The residual odor impressions are at a much lower level (Fig. 7). When the air supply was reduced to 1 cfm per man (excluding leakage) the average odor impressions were just above 2.0 units, above the acceptable level. As already stated, these records were obtained in order to gain information as to the odor level that the individuals exposed to such an environment might record. It follows that since exposure of the judges was only of one minute's duration, in comparison to the occupants where the exposure was considerably greater, that the scores attained would be of a higher order of magnitude than might be expected were the occupants to judge the quality of the air. In fact, the occupants, when questioned, could find no fault with the compartment conditions—they could detect no odors.

Odor Intensity in the Toilet Facility: One must realize that this environment consisted of exhaust air from the compartment in equilibrium with the air in this space, and that the exhaust air from the compartment already had an odor level of its own which increased with the decrease in replenishment air volume. Consequently, the odor conditions obtained within the toilet facility were plotted against replenishment air to the compartment.

For the primary odor impression, the maximum value obtained was 3.2 units at 1 cfm per man (Fig. 8), slightly above the average odor level found in the main compartment for a corresponding replenishment air volume. For the residual odor impression the value was 2.3 units, which is above the acceptable level and only slightly higher than the level in the compartment. One point is emphasized, namely, that the primary odor level was objectionable at the lowest compartment replenishment air volume of 1 cfm per man (approximately two complete air changes per hour) for the toilet facility, a level comparable to that recorded in the worst compartment condition. There is no reason to doubt that air flow to the toilet facility at the lower replenishment air volumes was nonexistent or that a reverse flow to the compartment may have occurred. Tests made at the entering and exhaust terminals to the toilet facility showed the necessary conditions were being obtained.

Effects of Temperature and Humidity on Odor Levels: For the same temperature of 78 deg ET, a decrease of dry bulb temperature from 85 F to 80 F does not appreciably alter the odor impressions. When the effective temperature, however, is elevated four degrees (78 to 82), there is some increase in the score of both primary and residual odor impressions.

Replenishment Air Supply in Relation to Reducing Substances in the Air: A series of experiments showed the permanganate method to be extremely sensitive for detecting the end products of tobacco smoke. On the other hand it was only slightly sensitive in detecting agents that give

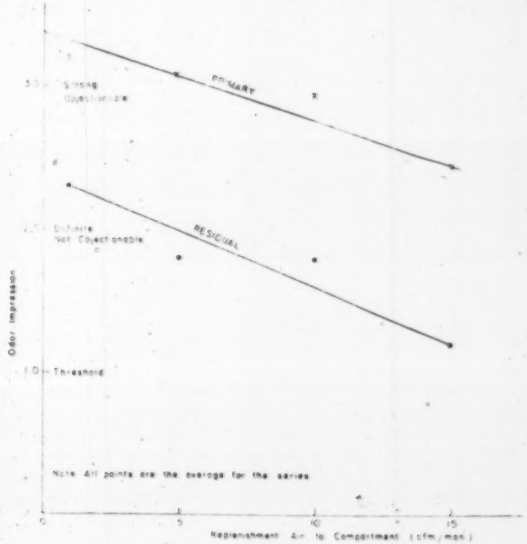

Fig. 8—Relationship of replenishment air to odor level in toilet facility. All air to the toilet was exhaust air from the compartment

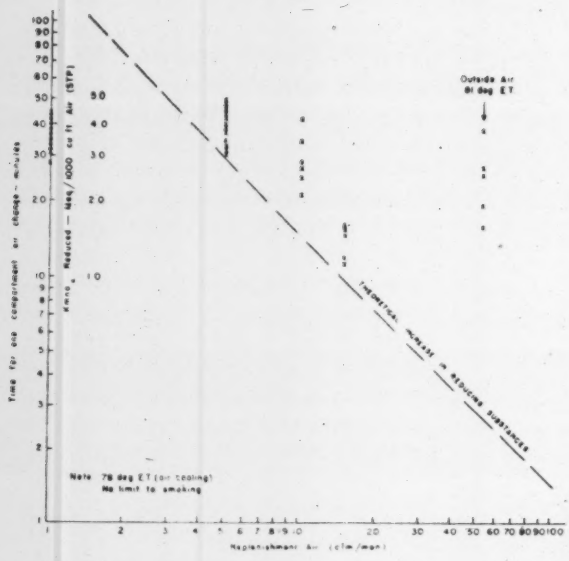

Fig. 9—Relationship of the amount of reducing substances in the air to the replenishment air supply

rise to body odors. For example, at 5 cfm per man, the permanganate method gave a value of 4.1 meq of reducing substances per 1000 cu ft of air when smoking was allowed (primary odor level 2.5), and only 0.7 meq when there was no smoking (primary odor level 2.0). Such findings indicate that the permanganate method has its greatest value in estimating the degree of pollution caused by tobacco smoke.

Since the end products of tobacco smoke chiefly determine the results obtained by the permanganate method, and assuming that the amount of smoke production is constant, then the amount of reducing substances plotted against the volume of replenishment air should result in a straight line on logarithmic coordinates (Fig. 9). The reducing substance values for the conditions between 5 to 15 cfm per man replenishment air parallel the curve fairly well, leveling off below 5 cfm per man. However, there was very little difference in reducing substances between the 5 cfm per man (air cooling) and 53 cfm per man (mechanical ventilation) condition.

According to the log-log plot, the value for 1 cfm per man should have been several fold the value found. These findings mean that the reducing substances were disappearing from the environment. Among the factors responsible may be condensation on cooling coil surfaces and subsequent removal with condensed water vapor, condensation on walls and furnishings, or leakage within the duct work. The fact that the tobacco odor was very strong in the condensate water, and that coil surfaces and duct work were coated with a tarry-like substance with a strong odor of stale tobacco indicates that absorption and condensation of the end products of smoking were in part responsible for the failure of the reducing substances to increase to the theoretical value. However, there is no doubt that leakage through duct work to adjacent spaces and through structural imperfections, and traffic to and from the chamber played a considerable part at the lower air flows, even though the compartment employed was considerably tighter than the average installation. Yet if leakage were the main factor involved, then the primary and residual odor values should not have increased above the value for 5 cfm per man replenishment air.

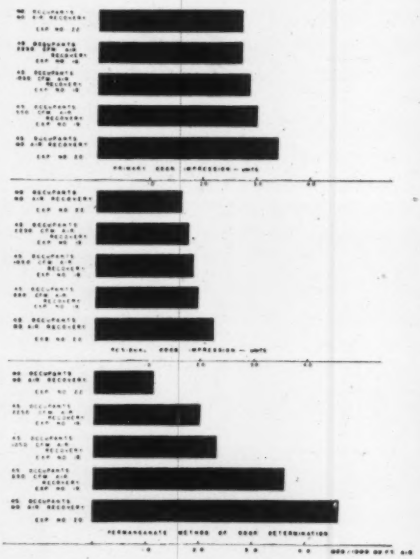

Fig. 10—Effect of activated carbon in reducing odor levels—1 cfm per bunk, 78 deg effective temperature, weather air low in water vapor, no limit to smoking

It is of interest to note the marked increase in the amount of reducing substances found in the environment by the permanganate method of 1 cfm per man when ducts and coils are not kept free from accumulated tar and lint. The increase in value from 3.9 to 7.7 meq of reducing substances found is to be expected since the more polluted the coil surfaces become the more will air by-pass the coil surface and the less would be the amount of odoriferous substances condensed and subsequently removed with the condensate water. This increase in reducing substances emphasizes the need for coil and duct cleansers and the importance of the wet cooling coils as a means of odor control.

Influence of Air Cooling and Subsequent Condensation of Odors and Water Vapor on Odor Removal

At 53 cfm per man and 81 deg ET the characteristic compartment odors were those of stale tobacco, humans, metallic material, and bedding. As the replenishment air decreased to 5 cfm per man, the odor of stale tobacco became more and more prominent and there was a definite decrease in the odor of bedding and metallic furnishings. At the same time there was an increase in body odor. At 1 cfm per man, the odor of stale tobacco became less, whereas body odor became more discernible. It should be noted that the same types of odors were detected at 1 cfm per man with air cooling (78 deg ET) as at 53 cfm per man with mechanical ventilation (81 deg ET).

From the standpoint of odor types present in condensate water, the odor of stale tobacco showed a progressive increase with reduction in replenishment air, whereas metallic or plumbing odors showed a decrease. Obviously, more and more odors due to stale tobacco were being removed as the replenishment air supply decreased and more air was being recirculated over the wet coils. Stale, musty, or body odor remained, practically at a constant level. These results substantiate the hypothesis that

in occupied spaces with unlimited tobacco smoking considerable odoriferous substances are removed by condensation on the cooling coils and in conjunction with condensed water and that the cooling coils can be used as adjuncts for odor removal.

The Influence of Activated Carbon In Reducing the Odor Levels

The system employed for cold weather operation was designed with cooling coil wet bulb control and dry bulb control of the heating elements. As already stated the condensate normally obtained from the cooling coils in the earlier experiments was rarely obtained under these conditions. Humidification was employed to obtain the necessary wet bulb conditions. Consequently, it is not unreasonable to consider the following experimental conditions as equivalent to those obtained by mechanical ventilation. All experiments were carried out with 1 cfm per man replenishment air (Fig. 10).

Primary Odor Impressions: The same value, namely, 2.7, was found whether the compartment was fully occupied or empty. The effectiveness of carbon in air recovery was demonstrated by the fact that the compartment was no more offensive when fully occupied under conditions which permitted unlimited smoking than the thoroughly scrubbed and aired, unoccupied compartment at 1 cfm per available bunk (experiments 16, 22). Odors detected during unoccupied compartment conditions were those of bedding, furnishings, and the slight presence of stale tobacco. The effectiveness of carbon in reducing to 2.7 units an odor level that otherwise would have been 3.4 units and objectionable is shown by a comparison of experiments 16 and 20. It should be pointed out that a the available surface of carbon is reduced (experiment 19) or the amount of air treated decreases (experiment 18), a rise in odor level occurs. It is, therefore, probable that a better distribution of carbon units would make this method even more effective.

In addition, it was noted that the compartment air, which prior to the use of carbon contained a heavy hazy smoke, became clear and relatively free from haze when carbon was utilized. Furthermore, the complaints of eye irritation, under similar conditions of 1 cfm per man replenishment air disappeared when carbon sorption was in effect. It may be that the felting on the carbon and its canisters caused by the high lint content within the compartment produced a filtering action on the tobacco smoke and aided in removing pyridine and other irritants. However, this possibility was not investigated.

Residual Odor Impressions: Under conditions of carbon sorption values below 2.0 units were found for the residual odor impressions.

Reducing Substances as Determined by the Permanganate Method: There were fewer reducing substances in the air in those experiments where carbon sorption was used and there was a progressive reduction in reducing substances when the carbon surface and air flow over the carbon bed were increased. From these data one may conclude that carbon if properly employed can become very effective in odor control under conditions of greatly restricted air supply.

Condition and Maintenance of Activated Carbon Units[3]: After two weeks' use all canisters and carbon were encrusted with a gray dust which consisted chiefly of lint. Otherwise, both materials remained in excellent condition. The carbon contained approximately 0.4 per cent by weight of dust, 4.4 per cent of organic material, and 1.8 per cent moisture. Alcohols, methyl amines and aldehydes were identified as constituents that went to make up organic materials. Minute quantities of sulfides, free sulfur or pyridines were also found on the carbon.

Effect of Ozone in Reducing Odor Levels

Exposure of the judges to ozone for 10 min before entering the test compartment resulted in a decrease in primary odor score (Fig.

[3]Analysis was performed by the manufacturer.

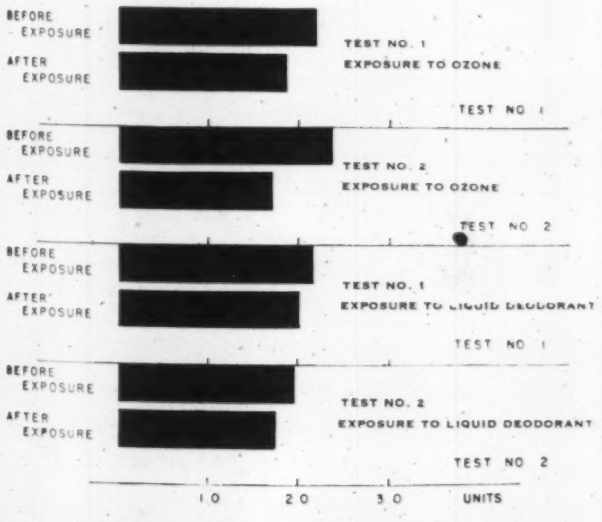

Fig. 11—Influence of liquid deodorant and ozone on odor level. 5 cfm per occupant, 78 deg ET. Weather air low in water vapor

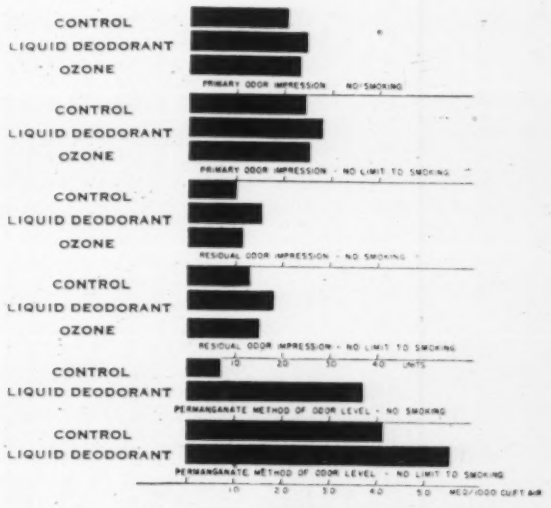

Fig. 12—Influence of liquid deodorant and ozone on odor level. 5 cfm per occupant, 78 deg effective temperature, weather air low in water vapor

Table 3—Effect of manipulation of compartment conditions on bacteria count at a replenishment air of 1 cfm per man

Experiment No.	Total occupancy	Compartment temp DB F	Compartment temp WB F	Bacteria per cu ft Plate	Bacteria per cu ft Impingement	Bacteria per cu ft Washing	Remarks
12	45	86	70	137	45	297	78 deg ET
13	45	89	74	180	75	287	82 deg ET
14	45	85	72	253	63	356	78 deg ET
15	45	85	72	220	61	263	78 deg ET
16	45	86	71	161	47	251	Conservation of air (carbon), 2250 cfm
17	45	85	71	167	42	174	Conservation of air (carbon), 2250 cfm
18	45	86	71	91	38	160	Conservation of air (carbon), 1100 cfm
19	45	84	69	87	50	198	Conservation of air (carbon), 550 cfm
20	45	86	71	94	42	234	78 deg ET
21	45	85	70	315	53	536	78 deg ET, no mattress covers
22	0	84	67	5	3	16	78 deg ET, no occupants

11). A possible explanation for this phenomenon, in agreement with the findings of previous investigators (14, 15), is that a fatiguing or a paralysis of olfactory receptors had occurred. By contrast, in another series of experiments when ozone was introduced into the test compartment unknown to judges, scores for both primary and residual odor impressions were slightly increased (Fig. 12). Even under the influence of masking produced by tobacco smoke, the compartment air was more disagreeable to the judges after ozone was introduced. It is probable that the reason for the findings of an increase in odor level may be explained on the basis that exposure time to ozone in these tests was too short in duration for the fatiguing effect to be observed.

Liquid Deodorant

An exposure of 10 min to the liquid deodorant produced the same fatiguing effect on the olfactory receptors as was found for ozone (Fig. 11). The fatiguing effect, however, is not as marked as with ozone. It is of interest to record that when the liquid deodorant was used in the compartment, analysis of air by the permanganate method showed an increase from 0.7 to 3.7 meq per 1000 cu ft of air (Fig. 12). When, in addition, smoking was allowed under the same conditions there was an increase from 4.1 to 5.5 meq.

The compartment primary odor level showed an increase when the liquid deodorant was introduced into the space as it did for ozone. Consequently, it was concluded that as in the case of ozone, preliminary exposure for approximately 10 min to the liquid type of deodorizer produces a paralyzing or fatiguing effect on the olfactory receptors.

The findings, namely, that *these substances do not control or oxidize odoriferous substances* are in agreement with the joint publication of the *National Institute of Health* and the *National Bureau of Standards* (11) and corroborate previous screening tests of the authors (10).

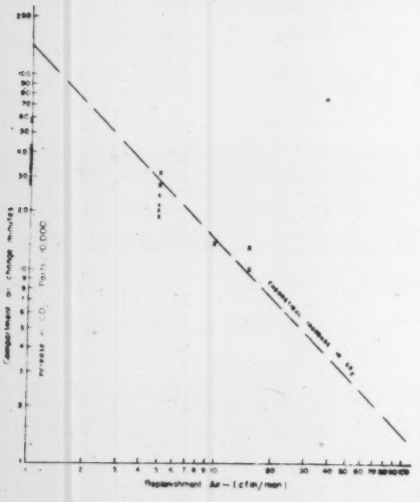

Fig. 13—Relationship of carbon dioxide concentration to replenishment air supply

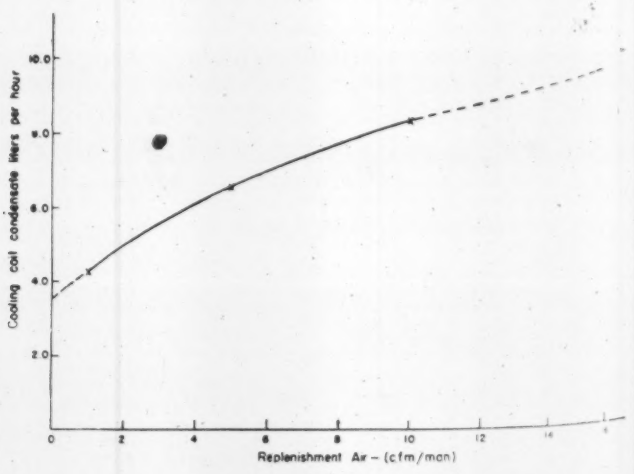

Fig. 14—Relationship of replenishment air volume to cooling coil condensate at 78 deg ET

Changes in Bacterial Concentration in Relation to Replenishment Air Volume

It was found that the bacterial count remained at an extremely constant level under conditions of from 53 to 1 cfm per man of replenishment air at 78 deg ET in the compartment.

The settling velocity as determined by the impingement and Petri plate counts remained fairly constant throughout the experiments.

The incidence of hemolytic streptococci was practically zero in all experiments. This may have been due to the absence of respiratory infections among the subjects during the five months' period of air sampling.

Cultures on the condensate water from the cooling coils were practically sterile.

With the recovery of air by carbon (Table 3), there was a definite reduction in total bacteria count. This reduction may be due to the filtering action of the carbon and its canisters in removing lint and dust from the atmosphere. In experiment 21 a significant increase in bacterial count was obtained by removing the fireproof mattress covers and thus exposing the bedding. The increase in settling velocity and bacteria per particle indicate that this increase was due to dust and fabrics rather than an increase in ventilation load by the occupants.

Concentration of Gases in Relation to Replenishment Air Volume

Carbon Monoxide: The carbon monoxide level due to tobacco smoking in confined spaces just reached 9 ppm (parts per million) at 1 cfm per man replenishment air, a level

well below the tolerable concentration for every day exposure. In fact, in some of our large metropolitan areas, the concentration frequently attains concentrations of 100-200 ppm.

Carbon Dioxide: The dilution curve of CO_2 produced at a constant rate should follow the log-log graph of Fig. 4. The analytical data, however, deviate from this curve, especially the values for 1 cfm per man (Fig. 13). Leakage is definitely a major factor in producing the deviation; although to a lesser degree, variation in activity of the occupants, and absorption of carbon dioxide by condensate water and furnishings are factors also (16). It is at the highest concentration of carbon dioxide that all these factors would be expected to manifest themselves. The highest carbon dioxide concentration obtained (0.60 per cent) was at the end of the first month of operations. At this time the subjects were most active and activity had to be restrained. The lower points were obtained when the experiments were well underway at which time most of the subjects were accustomed to the routine and consequently spent the greater portion of their time lying in their bunks.

The air cooling machinery was exceptionally tight and all possible points of air escape were sealed with plastic putty. However, the recirculation of approximately 2500 cfm of air involved a high pressure differential within the system, and consequently it was difficult to avoid some leakage. Opening and closing of doors, even with the use of an air lock as in this case, constitutes a large leakage factor where more than 45 men are involved.

It is significant that the carbon dioxide curve shows the same characteristics as does the permanganate curve. Whatever factors influenced the permanganate curve also probably were responsible for the characteristics of the CO_2 curve. However, neither of these curves showed any relation to the odor impression curves.

Concentration of Dust in Relation to Replenishment Air

The dust count remained fairly constant throughout the experiments irrespective of replenishment air volume. The particle sizes ranged from 1-3μ (microns). Lint, of course, was a large factor in contributing to the content and has been treated elsewhere in this report.

Miscellaneous Comments

Source of Condensate Water: When the quantity of condensate from the cooling coils is plotted against the quantity of replenishment air (Fig. 14) an almost linear relationship is observed. Since, at 78 deg E T, some sweating is to be expected in active men, it is quite possible that the value of 3.5 liters (0.123 cu ft) per hour obtained (extrapolation to 0 cfm per man) may have been due primarily to loss in body water. If one assumes that 3.5 liters per hour is mainly from the occupants, then at 10 cfm per man, the increase of 6.5 liters (0.229 cu ft) may be due to the moisture from the weather air.

The almost complete lack of condensate water during winter operations at 1 cfm per man cannot be completely explained. Since a quantity of 3.5 liters (0.123 cu ft) per hour did exist during summer operation, even complete dryness of weather air in the winter should not reduce the quantity of condensate to such a low level. As previously stated, activity of the subjects was at a very low level during the winter months, and this factor might have been responsible in part for the lack of condensate water production. However, the continuous movement of the 45 occupants from a relatively high compartment water vapor content to a low weather water vapor content may have been one of the causes for the lack of condensate water. Air leakage through duct work also was a definite contributing factor.

Maintenance of Cooling Coil Surface and Ducts: After one week's operation of the cooling machinery at the lower levels of replenishment air volume (1 cfm per man), the coil and duct surfaces were coated with a foul smelling mixture of tar-like substances and lint, formed from substances of human origin and end products of tobacco smoke. The insertion of a 20 mesh screen filter into the recirculation duct practically eliminated lint accumulation from the coil surface, but the accumulation of the lint on the screen necessitated its frequent removal and cleaning. Although the coil surface maintained most of its effectiveness when the screens were inserted, the coils and ducts continued to accumulate a thin layer of a tarry-like substance, which no doubt acted as a localized odor source.

With the introduction of a weekly spraying of the coil and duct surfaces with a dilute solution of tri-sodium phosphate and subsequent rinsing with water practically all traces of the foul smelling material were removed. This operation resulted in improved quality of compartment air. The fact that the permanganate level in the compartment at 1 cfm per man replenishment air was reduced from 7.7 to 3.9 meq per 1000 cu ft of air when a tri-sodium phosphate spray and rinse was used further demonstrates the effectiveness and necessity of periodic coil and duct cleaning.

Factors of Hygiene that Influence Cleanliness: In the earlier experiments, it was soon discovered that matters of hygiene and cleanliness could not be left to the discretion of the subjects. Accumulated debris such as periodicals, dirt, cigarette butts and filthy clothes left in out-of-way places made up a condition intolerable to fastidious individuals.

With the introduction of proper hygiene control and sanitation measures, this condition was soon remedied. It is quite possible that the constancy of dust and bacteria count and low level of odor encountered may have been in some way modified by such measures.

Vitiated Air: Frequently mentioned in the literature is the factor of *vitiated air*, wherein the occupants of such a space frequently undergo a loss of appetite and a disinclination to physical activity. The contrary was the case in these experiments. The subjects showed no loss of appetite, and restraint of the subjects was more of a problem than stimulation. As previously mentioned, at no time was there any complaint registered by the subjects indicating that the compartment environment was offensive.

Summary

The essential problem in this investigation was to ascertain the minimal quantity of replenishment air required in a simulated ship's berthing space to keep odors at an acceptable level in conjunction with air

cooling. Furthermore, activated carbon, ozone, and a liquid deodorizer were evaluated as means of controlling odors.

The principal factors involved in these studies were as follows: the quantity of replenishment air varied from 1 cfm to 53 cfm per man, gross air space was about 140 cu ft per man and the recirculated air varied between 35 and 60 cfm per man; the temperature of the compartment air was usually 78 deg E T (85 F dry bulb –72 F wet bulb); in the summer months the amount of cooling coil condensate formed from the excess moisture in the outside air and the occupancy of 45 subjects varied from 1 to 2½ gallons per hour, whereas no condensate formed in the winter months; the cooling coil temperature was usually maintained between 40 and 55 F in the warm weather and a standard of personal hygiene and cleanliness of the compartment commensurate with shipboard routine was maintained.

The odor level for the condition of 5 cfm per man replenishment air at a temperature of 78 deg ET with respect to the transient observer was of the same order of magnitude as that for 53 cfm per man for weather air. Odoriferous substances were condensed on the cooling coils and subsequently removed along with the water condensed from the air.

With activated carbon the replenishment air necessary for maintenance of an acceptable odor condition can be reduced considerably below 5 cfm per man. However, whether compartment leakage can be controlled so that dilution is less than 5 cfm per person is questionable, especially where large volumes of recirculated air are involved.

Ozone and the liquid chemical deodorant employed in separate tests did not reduce the odor level. Exposure to these substances, however, after a period of 10 min apparently exerted an anesthetic effect relative to odor perception.

Carbon dioxide, carbon monoxide, bacteria, and dust did not reach objectionable or noxious levels even with greatly reduced (1 cfm per man) replenishment air.

A chemical method based upon the reduction of an acid-permanganate solution by organic matter in the air proved to be of value in determining the degree of environmental pollution by the end products of tobacco smoke. The results, however, could not be correlated with the other odoriferous substances present, *e.g.*, odors of human origin.

Acknowledgments

The authors wish to express their sincere appreciation to Capt. E. G. Hakansson, (MC), USN, Capt. A. R. Behnke, (MC), USN, Prof. C. P. Yaglou, Messrs. Daniel Berres, George P. Lively, Welsh C. Whittlesey, Hugh T. Porter and E. Harry Culpepper for their timely advice and wholehearted support of the investigation; to Lt. Commdr. T. J. Duggan, H(S), USNR, and Chief Pharmacist's Mate J. D. Gillmore, USN, for their contributions to the bacteriologic phases of the investigation; to Pharmacist's Mates, USNR, N. L. Krueger, J. P. Hummel, R. T. Ottes, and J. A. Rae, for their contributions to chemical and physical methods of organic vapor detection; to H. A. Collison, I. D. O'Neal, H. I. Mark, W. T. Platt and R. S. E. Smith, for their contributions to the gas and dust phases of the problem; to J. N. Shaner, W. R. Boehme, S. Hollander, and J. Rohrback, for their contributions to the personnel phases. To those already mentioned and to Lt. Commdr. J. Hopkins, H(S), USNR, Lt. (jg) D. G. Doherty, H(S), USNR, and Ensign H. Schachman, H(S), USNR, the authors wish to extend their gratitude for the time and effort expended in judging the odor levels in the various spaces.

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ASHVE Laboratory

1946 REPORT of Committee on Research

L. P. Saunders
Chairman

T. H. Urdahl
Vice Chairman

by L. P. Saunders

DURING 1946 the purchase of the property at 7218 Euclid Ave., Cleveland, Ohio, by the Society provided a permanent research Laboratory. Almost every feature of the site and the buildings thereon has justified the wisdom of the decision to secure this property, which is ideally suited for research purposes. After several months of strenuous work the research program is once again in full stride with perhaps more work ahead calling for early attention than we have faced for many years.

The Committee on Research fully recognizes and gratefully acknowledges the wholehearted support which the Council has given it in 1946. The enthusiastic response by the Chapters and the membership at large to the voluntary campaign to reduce the mortgage on the property is encouragement which the Committee appreciates deeply.

Committee Activities

The Chairmen and members of 16 Technical Advisory Committees have shared with the Committee the responsibility of planning and supervising the research program. Fifteen meetings of Technical Advisory Committees have been held between January 1946 and the 53rd Annual Meeting, and 10 Committees are meeting within the next few days. These Committees are the life blood of our organization, and they play a most important part in the research program.

Industry Support

The appointment of C. A. McKeeman, effective February 1, 1946, as assistant to the President provided liaison between the Society and industry and provided for the solicitation of the funds which are a necessary supplement to general research funds, if we are to carry through any substantial part of the large and varied program before us. We are encouraged by the cordial reception which, he reports, our programs have in general received from the industry and particularly by the financial support afforded to certain specific programs now under way or planned for early attack.

Research Policy

A special Committee appointed by the Research Executive Committee has, under the Chairmanship of E. Holt Gurney, considered to what extent Society research might be expanded and the program broadened. Their report recommended that Article B-XIII of the By-Laws, namely, "The work conducted by the Research Laboratory of this Society shall be confined to a determination of the basic or fundamental principles or laws underlying all matters in the science of heating, ventilating and air conditioning," be retained in its present form with the broad interpretation that fundamental research includes the development of procedures for test codes but under no consideration permits commercial testing.

The Committee on Research suggests that Technical Advisory Committees should be constantly alert in reviewing codes and standards relating to heating, ventilating, and air conditioning in order to submit proposed changes to the Standards Committee of the Council.

Research Regulations

The proposed amendments to the regulations governing the Committee on Research submitted to the membership

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ASHVE Research Laboratory
7218 Euclid Ave., Cleveland 3, Ohio
(Tel.: EXpress 6161)

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INSTITUTIONS COOPERATING WITH THE COMMITTEE ON RESEARCH

Agricultural and Mechanical College of Texas, College Station, Tex.: The Effect of Secondary Turbulence on the Friction in a Flowing Stream of Water.

Case School of Applied Science, Cleveland, Ohio: Air Distribution in Rooms; Heat Transfer Coefficients of Freon Refrigerants.

Cornell University, Ithaca, N. Y.: Periodic Heat Flow through Composite Walls or Roofs.

Kansas State College, Manhattan, Kans.: Projection of Heated and Cooled Air Streams; Experimental Studies of Radiant Heating and Cooling.

Oregon State College, Corvallis, Ore.: Heat Transfer through Wetted Walls.

University of California, Berkeley, Calif.: Cooling Tower Design and Performance.

University of Illinois—College of Medicine, Chicago, Ill.: Physiological Adjustments of Human Beings to Rapid Changes in Environment.

University of Minnesota, Minneapolis, Minn.: Statistical Analysis of Variables Entering into Sensory Reactions to Summer Air Conditioning.

University of Toronto, Toronto, Ontario, Canada: Moisture Condensation on a Surface and the Measurement of the Dewpoint.

RESEARCH PAPERS—1946

1. The Sol-Air Thermometer—A New Instrument, by C. O. Mackey and L. T. Wright, Jr. (Ithaca, N. Y.) (May 1946, JOURNAL SECTION).

2. Forced Convection Heat Transfer Coefficients Along a Flat Surface, by George V. Parmelee and Richard G. Huebscher (Cleveland) (May 1946, JOURNAL SECTION).

3. Heat Losses Through Wetted Walls, by E. C. Willey (Corvallis, Oregon) (June 1946, JOURNAL SECTION).

4. Periodic Heat Flow—Composite Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (Ithaca, N. Y.) (June 1946, JOURNAL SECTION).

5. Energy Losses at Suction Hoods, by Allen D. Brandt and Russell J. Steffy (Cleveland) (September 1946, JOURNAL SECTION).

6. Psychrometric Instrumentation, by ASHVE Research Laboratory (Cleveland) (October 1946, JOURNAL SECTION).

7. Nature of Air Flow at Suction Openings, by Allen D. Brandt, Russell J. Steffy and Richard G. Huebscher (Cleveland) (February 1947, JOURNAL SECTION).

will, if approved, enable the Committee to extend its cooperative research activities as the occasion demands.

Publication Program

In the Chairman's Annual Report for 1945, Prof. G. L. Tuve drew attention to the urgent need for a change in the Society's publication policy for research reports. We view with satisfaction the recommendations on publication policy made by a special committee and approved by the Council in October. We believe that these changes will greatly increase the interest of most of the membership in the results obtained from Society research.

The two pages devoted to research news which have appeared monthly since August in the Journal Section are designed to keep the work of the Committee constantly before the membership.

Future Plans

A minimum budget of $75,000 has been set for 1947 and approved by the Council. If we are able to carry through, with industry support, some of the large programs now under development, this may be increased substantially. Plans are under way to develop a program of research in panel or radiant heating and cooling, to meet the challenge that the Society should assume leadership in solving this important problem.

The report of the Director of Research which follows includes details of activities at the Laboratory and cooperating institutions and of the Technical Advisory Committees.

Report of the Director of Research

By Cyril Tasker

Introduction

With the purchase and occupation of the property at 7218 Euclid Ave., Cleveland, O., the hope of some of those who set ASHVE Research in motion 26 years ago was fulfilled—the Society owned its Research Laboratory. It is no light task to move a going laboratory, and the writer wishes to express his thanks to the members of the Laboratory staff for the way in which the work was carried through. We are now in full operation once again, with all essential changes and construction completed. The spirit of the research staff is excellent; every one has been encouraged by the enthusiasm of those who have visited the Laboratory and have seen its possibilities.

The campaign among the Chapters to liquidate the mortgage on the property, encourages us to feel that the value of Society Research is being recognized by every member. This is a challenge to us so to serve the membership and industry that we can count on their continued and increased support.

Staff

There were few staff changes in 1946. In July we lost the help of Dr. Allen D. Brandt, who had been assigned to the Laboratory in October 1945, by reason of his resignation from the Public Health Service. An increase of the scientific staff will be needed in the near future, as we activate additional research programs.

Industry Contacts, Liaison and Publicity

The task of establishing and maintaining contact with industry was assigned by the Council in February 1946 to C. A. McKeeman, who is working in close liaison with the Director of Research and the staff. His visits to the leading industrial organizations and his discussions with officers of the various scientific, trade and industrial associations are beginning to bear fruit in a better understanding of our work, its possibilities and its limitations, and in increased financial participation as new projects are developed and existing projects brought to the attention of the industry.

Talks on the research program have been given before many Chapters of the Society during 1946. Staff members have visited many of the institutions where cooperative research work is or has been in progress.

The excellent facilities available at the Laboratory for meetings of committees have been well utilized since the end of July. The Research Executive Committee met on June 1 in Pittsburgh and on September 21 at the Laboratory. Many Technical Advisory Committees are meeting in Cleveland during the Society's 53rd Annual Meeting.

Some of the highlights of Society's Research have been presented each month since August 1946 in two pages of the Society's JOURNAL.

Our work is receiving greater attention abroad in the technical press of other countries, and our correspondence with foreign countries is increasing. We have had a number of foreign visitors this year and have established liaison with workers abroad by making them corresponding members of some of the Technical Advisory Committees. Senior staff members have continued certain inter-society activities which are of value in our research program.

Guide Activities

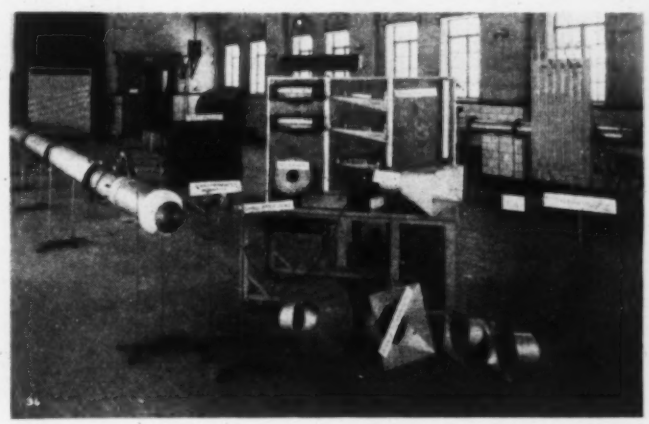
Close liaison has been maintained with the Guide Publication Committee, and all senior staff members have assisted in the review and revision of Guide Chapters.

Studies at the Laboratory and Cooperating Institutions

No report of ordinary length could do more than summarize the activities at the Laboratory and at the cooperating institutions, and those of the Technical Advisory Committees around which Society Research revolves. The details are available in the minutes of the meetings of the various Committees and in the progress reports made by the Laboratory staff and by those responsible for our cooperative studies. The Laboratory staff will be pleased to supply details to Society members and others on request. Those specially interested in certain projects are invited to visit the Laboratory and discuss them with the staff.

Air Flow, Distribution and Friction

Activity in programs classified under this general heading has continued throughout 1946. The Technical Advisory Committee on Air Distribution and Air Friction (Ernest Szekely, *chairman*) met at the Laboratory in July to review Laboratory and cooperative research programs. The air friction chart for round ducts, printed in THE GUIDE 1946, has been modified to include smaller ducts and



Apparatus used in studies on air flow into suction openings (Brandt, Steffy, and Huebscher)

lower volumes, and a paper was published[1] by the Society. Mr. Madison is chairman of the Sub-Committee on Air Friction.

Committee approval was given to the program for study of air friction in round, square and rectangular ducts and in fittings of the type normally used in air distribution systems. As the year closes the erection of the apparatus is nearing completion, and studies will be under way early in 1947. We have to thank several friends in the industry for their valuable assistance in securing many scarce materials and even scarcer equipment for these studies. This investigation should have widespread interest, since the data we hope to secure are fundamental for the design of air distribution systems. Sound and acceptable data should obviate the need for the use of the large factors of safety common in present-day design.

Cooperative Research

1. *Case School of Applied Science:* To extend the data already reported from this investigation, which have dealt with the air-stream patterns from various sizes and shapes of straight-flow grilles, nozzles, orifices and slots, further studies have now been made covering directional-flow grilles, perforated panels and very long slots. The static regain in long runs of duct with uniformly distributed outlets has also been investigated.

Wide-angle grilles giving air-stream angles up to 90 deg have been studied, and equations derived for the throw and the velocity gradients. Perforated panels of 5 to 15 per cent free area, in sizes of 1, 2 and 4 sq ft area, as well as complete perforated ceilings have been tested, and methods for determining static regain and the stream angle for such long-run air supply systems have been determined.

A report on the performance of directional-flow grilles, perforated panels, long slots and long duct runs with side outlets is in preparation.

2. *Kansas State College:* Essentially these studies are designed to investigate the downward projection of heated or cooled air streams, and the influence of initial flow conditions and of the surroundings and various structural obstacles upon the behavior of projected streams. The general procedure to date has been to set the initial stream temperature and velocity at desired magnitudes and run temperature and velocity traverses of the downward-projected stream. There have been serious problems in instrumentation especially in the measurement of very low velocities, but the test results to date have been encouraging.

Progress reports have been made covering the results obtained using the outlet of a straight pipe 6½ in. in diameter and 36 in. long as an orifice. The test results have been compared with tentative formulas based on theoretical considerations. Tests have also been made using a converging nozzle with an orifice diameter of 5¾ in. (0.48 ft). A report will be available early in 1947.

[1]Friction Charts for Gases Including Correction for Temperature, Viscosity and Pipe Roughness, by Richard D. Madison and Walter R. Elliot. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, October 1946, p. 107.)

Industrial Unit Heater Association

Following several discussions between officers of the *Industrial Unit Heater Association* and its Engineering Committee, members of the Technical Advisory Committee on Air Distribution and members of the Laboratory staff, a detailed program has been presented covering the investigation of the characteristics of air streams produced by downblow unit heaters. The proposal is now awaiting action of the Association.

Throw of Air from Slots and Jets

A paper[2] on the throw of air from slots and jets was published after study by the Technical Advisory Committee. Based on data given in papers by G. L. Tuve and his colleagues resulting from ASHVE cooperative research work at Case School, the paper presented some charts designed to simplify problems in air distribution. At the Laboratory H. B. Nottage is reviewing published information on ventilation jets as a preliminary to the development of a research program covering the performance of non-isothermal jets and the general movement of air in ventilated rooms.

Barometric Dampers

A study of so-called *barometric dampers* is being undertaken under the Technical Advisory Committee on Fuels. Since the earlier studies, which were based on the methods which have been used by others to investigate the performance of these appliances yielded little of real fundamental value, the studies were expanded to cover the examination of the flow of gases in a duct-tee section containing a swinging damper. A report entitled *What About Barometric Dampers*, intended for publication to stimulate interest in these studies, is at present in the hands of the Committee. Another paper entitled *Damper Mechanics* deals with the practical significance of the relation between the position of an automatic damper and the torque which must be applied to balance the damper in each position. It has also been distributed for Committee study.

The continuation of these studies must depend to a large extent on the financial support of those most interested in this type of control.

[2]Throw of Air from Slots and Jets, by Richard D. Madison and Walter R. Elliot. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, November 1946, p. 108.)

Equipment used in studies on damper mechanics—barometric draft controls

Industrial (Process) Ventilation

Dr. Brandt, with the assistance of R. J. Steffy and R. G. Huebscher, both of the Laboratory staff, completed two studies during the year. The first, described in a paper[3] presented at the Semi-Annual Meeting of the Society in June, 1946 dealt with energy losses at suction hoods. There were 175 different types of suction openings investigated, the energy losses at the entrance were determined, and coefficients of entry calculated. There was considerable discussion on this paper by those working in the field of industrial ventilation.

The results of the other study are reported[4] in a paper scheduled for presentation at the 53rd Annual Meeting, January 1947. Data were collected on the relationship of the centerline or axial velocity in front of suction openings to the volume rate of air flow on both unflanged and flanged hoods and on hoods having large flat surfaces adjacent to one or more edges. In the main, the tests confirmed Dalla Valle's equation for the centerline flow relationship for unflanged suction openings.

The collection and correlation of information on process ventilation and the collection of codes on the control of occupational diseases were completed prior to Dr. Brandt's resignation from the U. S. Public Health Service. The results of these surveys clearly pointed to the need for establishing factual and dependable data by experimental work. The collection of codes has been loaned to the Michigan Department of Health for analysis by one of its investigators.

Heat Flow and Heat Transfer

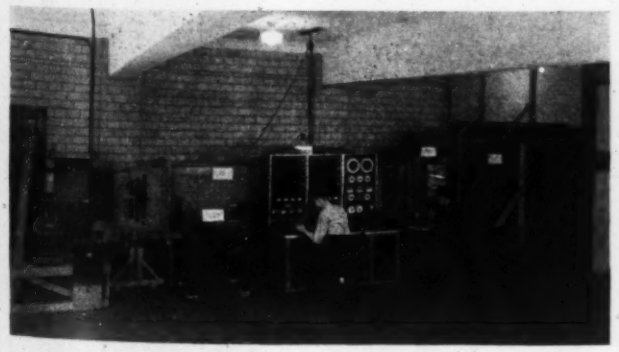
Studies under the Technical Advisory Committees on glass, cooling load, and insulation can be classed under this general heading. Substantial progress can be reported during 1946 with three papers published. Several other papers will be available in 1947 as a result of work completed and in progress.

Film Coefficients: A paper[5] on forced convection heat transfer coefficients was presented at the Society's Semi-Annual Meeting in June by two members of the Laboratory's staff. A report covering a continuation of these studies and dealing with laminar and laminar-turbulent boundary layers has been prepared for Committee study. The effect of forced convection on natural convection heat transfer has practical significance, and the Laboratory studies are being continued as time and personnel permit to determine the effect of widely spaced transverse ribs. In the fully equipped draw-through wind tunnel constructed for these studies we have a valuable piece of standby equipment; though it will take some time to complete the program, valuable data can be obtained with it in due course.

[3]Energy Losses at Suction Hoods, by Allen D. Brandt and Russell J. Steffy. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, September 1946, p. 105.)

[4]Nature of Air Flow at Suction Openings, by Allen D. Brandt, Russell J. Steffy and Richard G. Huebscher. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, February 1947, p. 101.)

[5]Forced Convection Heat Transfer Coefficients Along a Flat Surface, by George V. Parmelee and Richard G. Huebscher. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, May 1946, p. 112.)



Wind tunnel used in studies of forced convection heat transfer coefficients (tunnel plate and control panels were built at The Laboratory)

Measuring the intensity of solar radiation with the Smithsonian silver disc pyrheliometer

Solar Radiation Transmission Through Glass: The equipment for the study of solar heat transmission by glass and other materials, designed and constructed by the Laboratory staff, has been completed and test work is under way. Late in the summer we erected, in the rear of the Laboratory grounds and clear of obstructions and shading, a 12 ft by 12 ft test house, 11 ft high with over-hanging roof. It is equipped with electric power and gas, and the special test equipment is mounted on the roof, together with certain instruments for measurement of weather conditions. Inside the test house we have assembled all the control, measuring, and recording instruments needed in these studies. Though the erection was not completed until the late fall, we have been able to collect some data on heat gain from sky radiation through single glass. The winter months will enable us to obtain additional experience in operating the equipment so that a full program can be carried through in the spring and summer of 1947. Among the instruments erected on the roof is an Eppley pyrheliometer for the collection of solar radiation data which may be of value to the U. S. Weather Bureau.

A report on a comparison of experimental and theoretical data on solar heat gain through windows is before the Technical Advisory Committee on Glass for study and possible publication. We have not yet been able to publish much of the information contained in the comprehensive report prepared by Mr. Parmelee late in 1944 but hope to present it in a series of papers during 1947.

Periodic Heat Flow: The mathematical analysis of heat flow through walls and roofs under way at Cornell University under a cooperative research agreement was extended in 1945 to cover composite walls or roofs. The results were given in a paper[6] presented at the Semi-Annual Meeting, 1946. The same authors also presented at this meeting a paper on the sol-air thermometer.[7] The instrument described was designed and constructed to directly determine the temperature in the shade that would be equivalent to the combined effect of air temperature plus sun radiation and sky radiation during sunlit hours, or to the combined effect of air temperature and radiation to the sky at night. The instrument used in the studies at Cornell is now at the Research Laboratory and will be used to collect additional data in connection with the studies on solar radiation transmission discussed above.

At the Laboratory, Mr. Nottage has taken over the correlation of published work on periodic heat flow and the study of methods for the development of tables to give a simple basis for determining the instantaneous rates of heat flow through various solid structures. Such tables would simplify the work of the designing engineer.

[6]Periodic Heat Flow—Composite Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, June 1946, p. 107.)

[7]The Sol-Air Thermometer—A New Instrument, by C. O. Mackey and L. T. Wright, Jr. (ASHVE, Journal Section, *Heating, Piping & Air Conditioning*, May 1946, p. 107.)

STATEMENT OF INCOME AND EXPENSES—RESEARCH FUND

For the Fiscal Year Ended October 31, 1946

INCOME

FROM ASHVE			
40 per cent of 1946 and prior year's dues collected			$29,958.83
CONTRIBUTIONS—PER SCHEDULE			
General		$ 8,282.00	
Earmarked			
Contributions received	$14,950.00		
Add: Deferred from prior year	2,874.62	$17,824.62	
Less: Deferred to future operations	7,146.15	10,678.47	18,960.47
INTEREST FROM BANK DEPOSITS			3.19
TOTAL INCOME			$48,922.49

EXPENSES

CHAIRMAN AND COMMITTEE				
Traveling		$ 653.54		
Chairman's office		15.25		
Professional services		250.00	$ 918.79	
RESEARCH LABORATORY				
Salaries — Administrative and technical		$32,791.41		
Clerical		6,459.47		
Traveling		1,833.45		
Postage		394.51		
Telephone and telegraph		815.75		
Office expense and supplies		661.13		
Insurance		67.94		
Printing and mimeographing		409.68		
Library and periodicals		52.05		
Laboratory materials and supplies		2,857.94		
Depreciation — equipment and fixtures		1,319.16		
Unallocated		864.50		
		$48,526.99		
BUILDING OPERATIONS				
Cleveland rent	$1,053.41			
Real estate taxes	1,160.79			
Depreciation—building	1,036.66			
Interest on mortgage	947.19			
Property insurance	371.93			
Janitor	748.66			
Heating	539.61			
Electricity	464.65			
Building maintenance	196.42			
Water	84.60			
Gas	79.42	6,683.34	55,210.33	
COOPERATIVE RESEARCH				
Case School of Applied Science		$ 1,000.00		
Kansas State College		2,200.00		
Oregon State College		100.00		
State University of Iowa		250.00		
Texas A & M College		250.00		
University of Toronto		773.00	4,573.00	60,702.12
EXCESS OF EXPENSES OVER INCOME				$11,779.63

PARTICIPATING IN 1946 RESEARCH PROGRAM

*Air Devices, Inc.
Airtemp, Div. of Chrysler Corp.
*Aluminum Venetian Blind Co.
*American Air Filter Co., Inc.
*American Blower Corp.
American Rolling Mill Co., The
*Anemostat Corp. of America
*April Showers Co.
Barnes & Jones, Inc.
Bayley Blower Co.
*Bell Telephone Laboratories
Bethlehem Steel Co.
*Blue Ridge Glass Corp.
Brunner Mfg. Co.
*Buffalo Forge Co.
*A. M. Byers Co., The
Carrier Corp.
Chamberlin Co. of America
Chicago Pump Co.
Clarage Fan Co.
Crane Co.
*Detroit Edison Co., The
W. H. Driscoll
Duquesne Light Co.
Delmar C. Evans
*Farr Co.
*Ford Motor Co.
Forslund Pump & Machinery Co.
Frick Company (Inc.)

*Earmarked Contributions.

*Frigidaire Div., General Motors Corp.
*General Motors Corp.
G & O Mfg. Co., The
Hays Corp.
**Heating, Piping and Air Conditioning Contractors National Association*
Hoffman Specialty Co.
*Holcomb & Hoke Mfg. Co.
Ilg Electric Ventilating Co.
*Illinois Engineering Co.
Jenkins Bros.
*Johns-Manville
Johnson Service Co.
Keeney Publishing Co.
Kewanee Boiler Corp.
Kinetic Chemicals, Inc.
Kramer Trenton Co.
*La-Del Div., Joy Mfg. Co.
*Libbey-Owens-Ford Glass Co.
R. C. Mahon Co., The
Jas. P. Marsh Corp.
McDonnell & Miller, Inc.
McQuay, Inc.
Mellish & Murray Co.
*Minneapolis-Honeywell Regulator Co.
Modine Mfg. Co.
*Narowetz Heating & Ventilating Co.
Nash Engineering Co., The
National Radiator Co., The
*National Tube Co.
John J. Nesbitt, Inc.
*Perfex Corp.
Pipe Fabrication Institute
*Pittsburgh Corning Corp.
*Pittsburgh Plate Glass Co.
*Pyle-National Co., The
Raisler Corp.
W. R. Rhoton Co.
*F. C. Russell Co., The
*Sarco Co., Inc.
*Servel, Inc.
Spencer Thermostat Co.
Surface Combustion Corp.
Taylor Instrument Cos.
Timken Silent-Automatic Div., The Timken-Detroit Axle Co.
*Trade-Wind Motorfans, Inc.
Trane Co., The
United States Steel Corp. of Delaware (Carnegie-Illinois Steel Corp.)
*United States Testing Co., Inc.
Webster Engineering Co., The
W. H. Wheeler, Inc.
*L. J. Wing Mfg. Co.
York Corp.
*Young Radiator Co.

Volumetric Specific Heat of Building Materials: The volumetric specific heat is one of the properties of building materials needed in any calculations of periodic heat flow. The Laboratory was therefore assigned the task of collecting and correlating data on this property for the commonly used building materials. A comprehensive report by Mr. Nottage is before the Technical Advisory Committee on Cooling Load. Summary tables will be available shortly for consideration for publication and use in THE GUIDE.

Sub-committees of the Committee on Cooling Load have been working on appliances and lights and on absorptivity. Some of the data obtained will be included in the chapter on cooling load in the HEATING, VENTILATING, AIR CONDITIONING GUIDE, 1947, to which many members of the Technical Advisory Committee contributed.

Heat Transfer Coefficients of Evaporating Refrigerants: Studies have continued at Case School to determine the effect of the major operating variables upon the refrigerant-side heat transfer coefficient in an evaporator. It has been definitely established in these tests that this surface or film heat transfer coefficient may vary over a range of about 100 to 400, depending chiefly upon the evaporator load, but also upon the length of circuit and the temperature difference between the metal surface and the evaporating refrigerant. If it were possible to design and operate a given evaporator (such as a direct-expansion air cooling coil), so as to insure the maintenance of a refrigerant-side coefficient near the maximum of this wide range, smaller evaporators could be used for a given service. A full understanding of how the very low coefficients may be produced would clear up many operating troubles.

Insulation: A program initiated late in 1945 under the Technical Advisory Committee on Insulation to obtain more accurate and dependable values of the thermal conductivity of building materials has made satisfactory progress. Twelve laboratories, all having equipment conforming to the latest *ASTM* standards, have agreed to cooperate and have been supplied with samples of corkboard for test. Three laboratories have completed the first tests and submitted the results. All samples, after testing by the laboratory concerned, will be sent to the National Bureau of Standards where check tests will be made. It is expected that the new thermal conductivity values will be ready for THE GUIDE, 1949. The Committee is cooperating with the *ASRE* Insulation Committee so as to coordinate our test points with the values which *ASRE* will publish.

Heat Losses Through Wetted Walls: A paper giving the final results of the studies made at Oregon State College under a cooperative research agreement was presented[8] at the Semi-Annual Meeting in June 1946 by Prof. E. C. Willey.

Environment and Comfort

Comfort Reactions: In 1938 a series[9] of papers was published reporting studies, made in Minneapolis, on the shock experiences, general reactions and summer cooling requirements of 275 workers in an air conditioned office. Since many more data were collected than could be carefully analyzed at the time, arrangements were made with Prof. F. B. Rowley at the University of Minnesota to make a more complete statistical analysis.

His report, under study by the Technical Advisory Committee on Sensations of Comfort, (Prof. C. P. Yaglou, *chairman*) has raised a number of questions to which the Committee on Research should find the answers. The results appear to reiterate an important limitation of effective temperature which has troubled investigators in this field for some time. General experience in the past 25 years has indicated that the effective temperature index makes too much allowance for humidity at ordinary temperatures, and not enough allowance in very high temperatures which approach the limit of man's endurance to heat. This, Professor Yaglou suggests, is largely due to the fact that the index takes no account of acclimatization, though in 1922, when the index was developed, it had been assumed that it did.

It has been suggested that the Research Laboratory undertake further experiments to investigate the effective temperature index for humidity and for radiation. In view of the increasing interest in radiant heating systems, there is a moral obligation on the Research Laboratory to establish radiation correction factors.

Shock Effect: Just prior to the outbreak of the war the Society initiated a cooperative research investigation at the University of Illinois Medical School, Chicago, to study the so-called *shock effect*. The tests, which had to be discontinued in 1942, were resumed in the summer of 1946 under the direction of Dr. R. W. Keeton. They have to do with the determination and analysis of the physiological adjustments of human subjects in passing from a hot environment which demands free sweating to one conditioned for comfort, and in passing from a comfortable environment to a hot one.

In the studies made to date five healthy males have been used as subjects. To establish basic data they have been dressed in 90 per cent cotton union suits. The results show that the physiological adjustments made by healthy subjects occur very rapidly and place very little strain on the cardiovascular system. Later observations will be made on healthy female subjects and on both male and female subjects wearing typical summer clothing. Some physiologically impaired subjects will be used in the later tests.

These studies have an important bearing on all types of comfort cooling applications including transportation air conditioning. The Society is fortunate in being able to carry on these investigations at the Medical School in Chicago where the University of Illinois has extremely well equipped test rooms and a highly skilled and interested staff.

All Society research investigations dealing with any aspect of physiological reactions are regularly reviewed by the Technical Advisory Committee on Physiological Research of which Dr. C.-E. A. Winslow is *chairman*.

Air Conditioning in Southern Schools: The Delta Chapter has suggested that the Society undertake the planning and supervision of a series of studies to determine the effect of air conditioning in schools in the south. The proposal is under review by the Committee on Research.

Radiant Heating and Cooling

Interest in radiant heating continues, and the Committee on Research must take action in this field if the Society is to retain its leadership in studies in heating methods and systems. Very little work is being done in this country at present to determine fundamental design data for panel heating systems. Studies have been, or are being made, on specific systems or methods, but the results are limited in their application to the overall problem.

The Technical Advisory Committee on Radiation and Comfort (J. C. Fitts, *chairman*) has defined the scope of its activities as the "consideration of problems in connection with radiation as it affects comfort and the development of heat transfer design data as it affects these problems." Radiation was defined as "the net exchange of radiant energy between an individual and his surroundings." The Committee indicated that the problems were not restricted to any type or types of heating or cooling systems. The Laboratory has continued its survey of technical literature and has canvassed college and university laboratories throughout the country to determine whether research work in radiant heating or cooling was in progress or planned. In the main the results were negative except for one or two institutions where investigations are under way with or without the help of the Society.

[8] Heat Losses Through Wetted Walls, by E. C. Willey. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1946, p. 103.)

[9] ASHVE RESEARCH REPORT No. 1088—Summer Cooling Requirements of 275 Workers in an Air Conditioned Office, by A. B. Newton, F. C. Houghten, Carl Gutberlet and R. W. Qualley. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 337.)

ASHVE RESEARCH REPORT No. 1102—Shock Experiences of 275 Workers After Entering and Leaving Cooled and Air Conditioned Offices, by A. B. Newton, F. C. Houghten, Carl Gutberlet, R. W. Qualley and M. C. W. Tomlinson. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 571.)

ASHVE RESEARCH REPORT No. 1103—General Reactions of 274 Office Workers to Summer Cooling and Air Conditioning, by F. C. Houghten, A. B. Newton, R. W. Qualley and Edward Witkowski. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 591.)

Field Studies: The Laboratory has prepared the ground for conducting field tests of existing radiant heating systems in the Cleveland area in the hope of developing data for immediate use. A special surface thermocouple has been constructed to determine wall surface temperatures and an aspirated thermocouple made to eliminate the radiation effect upon air temperature determinations. A number of suitable homes have been located by C. M. Humphreys and plans made to initiate tests.

Kansas State College: These studies are designed to investigate the relationship between radiant heating and cooling, and human comfort and well-being. A test cubicle, 10½ ft sq, has been built within a larger room and equipped to enable the floor and portions of the walls and ceiling to be heated or cooled at will. Conditioned air can be supplied as desired to the test room and to the space between the test room and the enclosing structure. Details of the construction and instrumentation are given in progress reports made by Professor Linn Helander, under whose direction the studies are proceeding.

It is intended to correlate thresholds of comfort with mean radiant temperatures for various distributions of panel surfaces and varying air temperatures at a constant velocity of about 15 fpm. Skin temperatures will be measured, together with the temperatures of surrounding surfaces and the mean radiant temperature. A special radiometer has also been constructed. The judgment of an individual's comfort sensations will be accompanied by a determination of the physical quantities which represent the influence of the surroundings upon the energy balance for his body.

A progress report covering an analytical study of the emissivity of unheated surfaces as a factor in the design of radiant heating systems has been submitted to the Technical Advisory Committee for study.

Cooperation With Other Organizations: Acting for the chairman of the Committee on Research, the Director of Research and Mr. McKeeman met with the Research Committee of I=B=R in Chicago on December 10, 1946, to discuss the possibility of cooperation in the field of panel heating research. It was finally proposed that representatives of all groups having an interest in panel heating or cooling be invited to a meeting in Cleveland early in March, 1947. This meeting would, it was hoped, crystallize the various ideas on research into panel heating. The Laboratory would present a suggested research program for the development of basic data needed in the design, installation and operation of radiant heating systems with estimates of the probable length of time involved and some approximation of cost. It was agreed that most of the industries referred to as being interested in panel research had representative trade organizations which should be asked to delegate official representatives to attend the meeting. The Laboratory was instructed to proceed with the preliminary plans for this meeting and for the presentation of the program.

Miscellaneous Studies

Air Cleaning: In January, 1946, the Technical Advisory Committee on Air Cleaning (R. S. Dill, *chairman*) voted that a program of research and test work be developed with the ultimate aim of recommending sound and acceptable codes for the testing and rating of air cleaning devices. It was suggested that funds be solicited from both manufacturers and users to enable a qualified investigator to be engaged for full-time work at the Laboratory. A tentative program was drawn up and a proposal circulated to those likely to be interested. At the year's end sufficient funds were in hand or pledged to enable a start to be made on this program. These studies are of considerable importance to the future of air conditioning, and the problem is receiving considerable attention at the present time not only in America but also abroad. There is apparently considerable dissatisfaction with the present status of the testing and rating of air cleaning devices.

Psychrometry: The studies on the measurement of the dewpoint of air-water vapor mixtures, under way at the University of Toronto under a cooperative research agreement, have reached the stage where a completely automatic dewpoint hygrometer has been designed and built and its operation tested over a wide range of conditions. The report on this work states that "the most noteworthy conclusion drawn from observations with the instrument is that an apparently large difference may be observed between the theoretical and actual dewpoint of moist air." Further work would seem to be advisable and the University of Toronto is planning to continue these studies.

In October the Laboratory presented a paper on psychrometric instrumentation.[10] Its purpose was to provoke discussion and study of this important branch of air conditioning.

A sub-committee of the International Joint Committee on Psychrometric Data has been examining the differences on certain fundamental concepts and constants which apparently exist among the organizations and countries represented on the Joint Committee, as a preliminary to the construction of a new set of international psychrometric tables.

Weather Design Conditions: The Committee on Weather Design Conditions (T. H. Urdahl, *chairman*), has made a complete analysis of the annual weather data for Detroit, Mich., over the five-year period 1935-1939, inclusive. The major part of the credit for this analysis should go to J. C. Albright,[11] a member of the Committee. The report is being carefully studied so that a method of presentation acceptable to those interested in such data can be set up as a model for the other 116 stations for which complete data are available. The importance of accurate weather data and of the incidence and co-incidence of temperatures, relative humidities, and wind velocities is being more fully realized day by day. With the data available the Society can make a distinct contribution to a better appreciation of the significance of design conditions.

Corrosion: The activities of the Technical Advisory Committee on Corrosion (Leo F. Collins, *chairman*) have been devoted exclusively to the preparation of a proposed chapter on water-formed deposits and corrosion for THE GUIDE. It covers problems of scale, sludge and slime formation in all types of heating and ventilating equipment employing water, and discusses corrosion on the interior and exterior surfaces of such equipment.

Sorbents: Much of the activity of the Technical Advisory Committee on Sorbents (John Everetts, Jr., *chairman*) has consisted of the revision and rewriting of Chapter 38, Dehumidification by Sorbent Materials of THE GUIDE 1947.

Sound Control: Following a meeting of the Technical Advisory Committee (R. D. Madison, *chairman*) in July, arrangements were made for Committee participation in studies to be made by the U. S. Navy to determine the best methods for acoustical testing of ventilating fans and systems and to establish a method of predicting the acoustical performance of ventilating systems. A research program, drawn up by the Bureau of Ships, was submitted for Committee study and comment, and work is now under way at the Material Laboratory, U. S. Naval Shipyard, New York.

Through Committee action, the help of the Bureau of Standards and *American Standards Association* was also sought in the problem of the testing and calibrating of sound measuring equipment to improve correlation between tests made with various instruments and at differing institutions.

Acknowledgment

The writer respectfully acknowledges both on behalf of the Research Laboratory staff, and personally, the encouragement and help given during the year by the Chairmen and members of the Technical Advisory Committees, by members of the Committee on Research and especially by the Chairman and the members of the Research Executive Committee. They have made a difficult and yet, we believe, an important year more effective than it might have been.

[10] Psychrometric Instrumentation (A review of the accuracy of psychrometric instruments and their application.) (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1946, p. 101.)

[11] Analysis of Summer Weather Data in the United States, by J. C. Albright. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 397.)

The 53rd Annual Meeting

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Hotel Statler, Cleveland, Ohio
January 27-30, 1947

THE 53rd annual meeting of the Society attracted an attendance of 2165 members and guests—the largest number ever present at a Society meeting. Attendance at the 7th International Exposition at Lakeside Hall, limited by invitation to those interested in heating, ventilating, and air conditioning equipment, was over 30,500.

The new ASHVE Research Laboratory at 7218 Euclid Ave., Cleveland, which was purchased by the Society in 1946, was dedicated and was open for inspection during the entire annual meeting, thus affording the members an opportunity to become acquainted with the laboratory staff and to see the facilities available for the contemplated research program.

First Session—Monday, January 27, 10:00 A.M.

The first session was held in the new Research Laboratory in order to include the dedication ceremonies and was attended by 500 members and guests. J. E. Wilhelm, Cleveland, president of Northern Ohio Chapter, welcomed the members to the meeting. Pres. Alfred J. Offner, New York, extended the thanks of the Society to the Northern Ohio Chapter for their hearty welcome, as well as for the excellent work which had been done by the Committee on Arrangements in preparing for the Annual Meeting.

President Offner then introduced Dr. Arthur C. Willard, Urbana, Ill., past president of the Society and president emeritus of the University of Illinois, who gave the address of dedication as follows:

This is a notable occasion in many respects in the history of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

We have met here to dedicate a building devoted to research in those arts which most intimately affect the comfort and health of human beings.

This enterprise is not new, as it already has an impressive record of achievement preserved in the many volumes of TRANSACTIONS published by the Society. These achievements have been made possible by the efforts of many men and they will have an inspiring influence on the staff who will carry on here the search for new and better scientific knowledge in the many fields related to human comfort and health.

It is certainly appropriate at this time to review briefly the origin and development of the Research Laboratory which has a history extending back some thirty years. In so doing, we will pay tribute to the *founding fathers* who conceived the idea of such a Laboratory. Such recognition is due these far-seeing and courageous pioneers in research, and it is good for us who are here today to recall them and their hopes and aspiration.

Alfred J. Offner
New York, N. Y.

I think you will all be interested in the first formal action taken in 1917 by the Society, during the presidency of J. I. Lyle, on the establishment of a Research Laboratory. The Record appears in the TRANSACTIONS for 1917, Vol. XXIII, p. 322 and following. Here is part of what you will find:

REPORT OF COMMITTEE* ON RESEARCH BUREAU

At the last Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, the following resolution was adopted.

RESOLVED: That a committee be appointed to investigate the possibility of establishing a Research Laboratory on some basis and the ways and means for starting it; one member of this Committee is to be from the Council.

Our President, in pursuance with the action above referred to, appointed a committee which at this time desired to submit for consideration the following:

FIRST: Your committee believes that the time has arrived when the Society needs a Research Laboratory;

SECOND: Ways and means of establishing such laboratory considered by your committee were as follows:

(*Note:* Items a, b, c, d, which follow refer to details of *ways and means* and are omitted because of space and time limitation.)

In conclusion, your committee would recommend the establishment of a Research Laboratory, preferably by the U. S. Bureau of Standards, under the control of the Society; if that is not feasible, to establish a Chair at a University whose students shall make tests under the direction of an authorized member of the Society, and that the expense of the establishment of such a Chair shall be met by an increase in the dues, and the establishment of life members as above outlined.

Your Committee respectfully submits the foregoing as its report, and would ask that it be discharged.

George W. Barr, *Chairman.*

H. M. Hart	W. W. Macon
J. D. Hoffman	James W. H. Myrick
Wm. F. McDonald	Perry West

COMMITTEE ON RESEARCH BUREAU

On motion of Frank K. Chew, the Report was received and the proposed increase in dues for research was immediately discussed and the Committee was continued.

*This committee was appointed pursuant to a resolution passed at the Annual Meeting of the Society in 1916 during the presidency of H. M. Hart.

The TRANSACTIONS for 1918—F. R. Still, president, and for 1919—W. S. Timmis, president, contain very complete reports on the proposal to establish a Research Laboratory under the sole control of the Society. Throughout this period, the whole membership enthusiastically supported the proposal and this support was especially marked by the devoted work of Homer Addams, J. R. Allen, F. F. Bahnson, C. A. Booth, Mr. Chaffee, F. K. Chew, J. H. Davis, S. E. Dibble, M. W. Franklin, F. E. Giesecke, H. M. Hart, J. D. Hoffman, C. A. Humphreys, A. S. Kellogg, G. B. Larimer, E. E. McNair, L. W. Moon, E. T. Murphy, C. W. Obert, Arthur Ritter, and W. S. Timmis.

On August 1, 1919, during the presidency of Walter S. Timmis, The Research Laboratory was officially established and began to function at the United States Bureau of Mines, Pittsburgh, Pa.

The first Director of the Laboratory was John R. Allen, a brilliant scientist who had served as Dean of Mechanical Engineering, University of Michigan and as Dean of Engineering and Architecture at the University of Minnesota.

After the tragic death of Dean Allen in October 1920, Dean L. A. Scipio of Robert College, Constantinople, Turkey, served for a year during his leave of absence from the College.

On August 1, 1921, the directorship of the Laboratory was assumed by F. Paul Anderson, Dean of the College of Engineering, University of Kentucky.

In September 1925, Ferry C. Houghten became the Director and served until his entry into the Navy in World War II.

On October 1, 1943, Cyril Tasker was appointed Director of Research and took charge of the new Laboratory facilities at Cleveland, which were temporarily located at 10700 Euclid Avenue. At the end of the two-year lease, it was found necessary to look for other quarters and a special committee composed of, E. N. McDonnell, *chairman;* M. F. Blankin, L. E. Seeley, A. E. Stacey, Jr., G. L. Tuve, T. H. Urdahl and B. M. Woods, recommended the purchase of a building at 7218 Euclid Ave., which came into the Society's possession in July 1946.

Ever since its establishment, the Research Laboratory has had the loyal and untiring support and cooperation of the members of the Society. They have served on its Research Advisory Committee, and on the numerous and important Technical Advisory Committees. There are now sixteen of these advisory committees with an average membership of 10 men, who are especially qualified to advise in the various research projects under study and investigation by the Laboratory. The present organization of the Committee on Research includes L. P. Saunders who is now chairman. The other members of this Committee are: T. H. Urdahl, Vice Chairman; A. C. Fieldner, Ex-Officio; Cyril Tasker, Director of Research; L. N. Hunter, C. O. Mackey, R. D. Madison, L. G. Miller, R. M. Conner, John A. Goff, F. W. Hutchinson, R. K. Thulman, W. E. Zieber, C. M. Ashley, F. E. Giesecke, F. C. McIntosh, G. L. Tuve. It will, therefore, be apparent that no less than 175 members of the Society are now conversant with and officially responsible for various phases of the over-all research program of the Society.

From its inception, the Research activities of the Society have included the cooperation, through numerous research agreements, of many universities and scientific institutions as well as government agencies. The first of these cooperative research programs was set up in 1919 at the University of Minnesota under the able direction of Prof. F. B. Rowley for the study of radiant heat losses from direct radiators. Other cooperating universities and institutions include: Carnegie Institute of Technology, Case School of Applied Science, Cornell University, University of California, Georgia School of Technology, Oregon State College, University of Pennsylvania, Agricultural and Mechanical College of Texas, Lehigh University, Rensselaer Polytechnic Institute, University of Illinois, and the University of Wisconsin.

As an important section of this brief review of the origin and development of the Research Laboratory during the past thirty years, I wish to pay special tribute and grateful acknowledgment for the invaluable financial support received through the generous contributions of funds from industrial firms and various associations and institutes. Again, limitations of space and time prevent me from naming each of these contributors but a fairly complete list of these donors appears in the TRANSACTIONS for 1944, Vol. 50, p. 30, under the Report of the Committee on Research, Chairman C. M. Ashley, covering *Twenty-five Years of Research.*

The amount of these sustaining contributions over the years is most impressive, since they total more than half of all the expenditures for Society research from 1919 to 1946, inclusive. That total is approximately $925,000—of which $445,000 came from Society dues and appropriations while approximately $480,000 came from industry, associations, expositions, Navy, individuals and other sources. In this connection, it should be noted that in 1925 the Society dues were raised to $25 and 40 per cent of all dues were allocated to the Research Fund.

At this point it would be appropriate, if time permitted, to introduce by title, at least, all of the many research projects sponsored by the Society, for which time, thought, energy and money have been spent since the Laboratory was inaugurated at the U. S. Bureau of Mines in 1919. The list of these projects would be most impressive in both quality and quantity as the number of papers and reports resulting from research at the American Society of Heating and Ventilating Engineers Research Laboratory and at cooperating institutions is approximately 285. This total does not include literally hundreds of articles, reviews, summaries and interpretations of Society research which have appeared in various technical and trade journals and in the scientific journals of other professional societies. The Research Laboratory and the Society owe a great debt to these other publications for disseminating and publicizing the results of these researches. Research, such as ours, which is conducted largely in the public interest can only become really effective when it is given the widest possible publicity and adequately interpreted. For this purpose, scientific journals alone are not adequate and never will be.

This vast fund of knowledge based on the sciences related to the arts of heating, ventilating, and air conditioning is all recorded in the TRANSACTIONS of the Society for the benefit of all mankind. The members of the Society are justifiably proud of such a record and the further fact that this Society is the only professional engineering organization which maintains and operates its own Research Laboratory.

The results of this research must be interpreted and translated by industry into the processes and equipment necessary to improve the physical environment of our homes, offices, hotels, theaters, churches, and factories, as well as our trains, ships, and planes for greater human comfort, health, happiness, and efficiency. No field of research demands more skill in the successful application of its scientific findings than the field of heating, ventilating, and air conditioning. This Society must never forget that its research, no matter how brilliant the staff and their achievements, is not an end in itself. Only the trained engineer can make the results of scientific research in this field fully effective for the benefit of mankind.

And so with this wonderful record of achievement to inspire us all, we dedicate this new home of the Research Laboratory of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS to the discovery of new knowledge and the improvement and extension of our present knowledge in all fields related to the arts of heating, ventilating, and air conditioning. *This Laboratory will always seek to promote the comfort and health of human beings through scientific research.*

I congratulate President Offner and Director Tasker and his staff as we face the future and *carry on* in the best research traditions of our Society for service to mankind.

President Offner thanked Dr. Willard for dedicating the Laboratory to the service of the membership and the heating and ventilating industry.

G. Brooks Earnest, president of The Cleveland Technical Societies Council, expressed his pleasure at the

establishment in Cleveland of the Society's Research Laboratory, which he felt was a valuable addition to the facilities already established in Cleveland for engineering development.

Dr. William E. Wickenden, president of Case School of Applied Science, Cleveland, referred to the close cooperation that had existed between Case School and the Society in promoting research in problems of interest to both. He pointed out that the cooperative research work had been of value, not only to the Society, but even more so to Case School in providing an opportunity for development of engineers who were thereby fitted to render valuable service to the industry.

President Offner then presented the president's report.

President's Report

The year 1946, just passed, was an eventful year for our Society in many ways. It has moved forward in research, membership, publications and in its value to the public, industry and its members.

During the past year we have consummated our hopes and aspirations of many years—to own our own Laboratory property. The purchase of the buildings and property located on Euclid Avenue in Cleveland was the largest financial transaction ever undertaken by the Society. It represents an investment of over $80,000—$70,000 for the property and over $10,000 for improvements. One half of the purchase price, or $35,000 was paid on delivery of the deed, the balance being covered by a bank mortgage. Part of the principal has already been paid off. We have hopes of liquidating the remaining balance of the mortgage in the very near future by means of voluntary contributions from members and friends of the Society.

The purchase of the Laboratory property, our increased research program, increases in the costs of publishing THE GUIDE and the increase in the costs of other activities of the Society have made large demands on our finances. However, prudent management and care leave our financial position at the end of our fiscal year in a sound position.

The Fund Raising Campaign for Research from industry was inaugurated during the past year. These funds are to supplement the 40 per cent allocated to research from membership dues, as required by our Constitution, the moneys allocated by the Council from time to time and the profits received from our editorial contract, THE GUIDE and from the Heating and Ventilating Exposition. The funds are being solicited from industry and their trade associations on a business basis to carry on basic studies of technical problems which are of direct benefit to industry. Therefore, these funds are not solicited as a contribution or charity but for actual value received. The Society has engaged the services of Clyde A. McKeeman, a member, to actively carry on this work and he has been laying the groundwork for this very important work during the past few months. We have great hopes and expectations for this new endeavor of the Society.

Our Research Laboratory is unique among engineering societies, in that we are the only national engineering So-

53rd Annual Meeting
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
Dedication of the ASHVE Research Laboratory
January 27, 1947

Speaking: Pres. Alfred J. Offner, New York, N. Y.
Seated (left to right): J. E. Wilhelm, president of Northern Ohio Chapter; Dr. Baldwin M. Woods, Berkeley, Calif., 1st vice president of ASHVE; Dr. Arthur C. Willard. Urbana, Ill., past president of ASHVE; George L. Tuve, Cleveland, Ohio, 2nd vice president of ASHVE

ciety to own and operate such facilities. It deserves the full support, not only of industry, but of every member of the Society.

The 1947 issue of THE GUIDE will be the 25th Anniversary edition. During the 25 years of its existence, it has grown both in importance, in usefulness, in the amount of technical and usable information and in size. It has grown from an issue of 5000 copies in 1922 to over 17,000 copies for the 1947 issue, from 192 pages of technical data to 912 pages, and from 133 pages of manufacturers information to 334 pages for the new issue. The 12,000 copies of the 1946 issue of THE GUIDE that were printed were completely sold out, necessitating a second printing of 3000 copies which were sold before they came off the press.

A change in our policy of publishing research papers has been made. In the future, research papers may be published in the JOURNAL, either as a complete report or in abstract form. If published in abstract form, the complete report will be published as a separate bulletin for distribution to members and others interested in same.

A change in the method of nominating the officers and members of the Council, as voted by the membership, goes into effect at this meeting. The new nominating committee consists of 11 members and 2 alternates, distributed in 7 geographic areas, 4 selected by the Council and 7 by the Chapter Delegates Committee. This committee replaces a much larger nominating committee, consisting of a member from each Chapter, which method has been in use for many years.

One of the duties imposed on the president, and shared by the other officers, is the visiting of chapters for the purpose of meeting with and becoming better acquainted with the membership at large. During the three years of such visits, I have traveled from north to south and from east to west, visiting 32 of the 38 chapters we now have. I am sorry that time did not permit my visiting the remaining 6. During the past year, two new chapters have been added, the Virginia Chapter at Norfolk and the Southwest Texas Chapter at San Antonio. A Student Branch has also been formed at Texas A. & M. The Society passed its 5000 membership mark in August and now has nearly 5400 members, an all time high in the Society's history, an increase of about 800 members during the year. This year also finds the resumption of the Heating and Ventilating Exposition after a lapse of seven years due to the war.

I wish to take this opportunity to express to the membership my sincerest thanks for the honor they have conferred upon me and the confidence they have shown in electing me as their President. I hope I have lived up to your expectations. I also wish to thank my fellow officers, the entire Council, all committee chairmen and their members, and all others who have done such splendid work in advancing the interests of the Society. My personal thanks also goes to Secretary Hutchinson, Technical Secretary Flink and Director Tasker and all staff members of the New York office and those at Cleveland for their loyal support. Without the help of all these, the Society would not have made the advances it has made during the year 1946. I have enjoyed every minute of my term of office. It also has been a personal privilege and pleasure to serve the Society in all of the 25 years that I have been a member, and I hope I will be permitted to continue to do so in the future.

Respectfully submitted,

Alfred J. Offner, *President*

The report of the Council was presented by the secretary, A. V. Hutchinson.

Council Report

The Council held five meetings since the 52nd Annual Meeting, namely, in New York, St. Louis, Montreal, Atlanta and Cleveland.

At the organization meeting President Offner announced his committee appointments which were unanimously confirmed by the Council. A new office was created, Assistant to the President, and Clyde A. McKeeman was appointed. A. V. Hutchinson was reappointed Secretary; Carl H. Flink was continued as Technical Secretary. Depositories for

Members attending the 53rd Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, January 27, 1947, in new ASHVE Research Laboratory, Cleveland, Ohio.

funds were selected and a certified public accountant was appointed.

The Council voted to purchase property in Cleveland for the Research Laboratory, at a cost of $70,000 for the land and buildings at 7218 Euclid Ave. For the down payment of $35,000 current funds were used with the amount in excess of $50,000 in the Reserve Fund. A proposal was made that money from the present Endowment Fund be obtained to replenish the operating funds used. An additional $10,000 was allocated for moving and alteration expenses.

With the new Charter in effect a study of the Constitution and By-Laws was authorized. An increase in the advertising rates for THE GUIDE, 1947, was put into effect.

Meeting places for June 1946 and January and June 1947 were selected.

Petitions for a Charter for a Virginia Chapter and a Southwest Texas Chapter were favorably acted upon and a Student Branch at Texas A. & M. College was approved.

An employees' pension plan was studied and approved for professional personnel with a contributory feature.

The Council nominated five men to serve for a three-year term on the Committee on Research and under the new By-Laws, four members and an alternate for the Nominating Committee were selected.

A revised publication procedure and policy was approved.

The Budget for 1946-47 was adopted providing for an estimated income of $170,685 and an expenditure of $158,500 for general activities and $75,000 for Research.

A new form of membership application and some simplification of the election procedure was adopted.

The Council acted in accordance with the Constitution and By-Laws on all matters required, also accepted 39 resignations, canceled the membership of 21 for non-payment of dues and records with deep regret the death of a Charter Member Charles F. Hauss, former Treasurer F. D. Mensing, 8 Life Members and 29 other members.

Respectfully submitted,

THE COUNCIL

Secretary Hutchinson presented the secretary's report.

Secretary Report

The year 1946 was an eventful one for the Society and recorded six significant items:

1. The amendment of the Charter.
2. The highest level of membership—5285.
3. The largest number of new member applications in any one year—1029.
4. The acquisition of our own Research Laboratory Building in Cleveland.
5. The largest edition of THE GUIDE ever published and the highest circulation.
6. The organization of two Chapters and one Student Branch.

The Secretary's office handled the innumerable details connected with election of 880 members; the billing and collection of dues, solicitation of Guide advertising and the sale of copies; the editing, proofreading and publishing of meeting papers, Guide text and the TRANSACTIONS, Vol. 51; made arrangements for meetings, officers' trips, chapter speakers, and all other activities required by the Constitution and By-Laws.

With reconversion from war the return of members from service was rapid and reflected by reduction of the service roll from a high of 427 to a present level of 158. Changes of addresses have been very heavy during the year and required much paper work to keep our records clear.

The compiling of Council Minutes, proceedings of meetings, and correspondence with chapters required much time. The Secretary was privileged to visit 15 of the chapters and found them active and progressive in advancing the Society's program of activities.

The records and books of the general and research activities of the Society were kept in the headquarters office and funds received for deposit $210,592.70 and disbursements were $217,459.21 as verified by the Certified Public Accountant.

Due to limited staff and several personnel changes during the year, it was not always possible to handle all administrative work as expeditiously as desired, but it is hoped that during this period of rapid Society growth we can effectively keep pace with developments and the needs of the members.

It was a matter of great personal pleasure and satisfaction to me to receive the handsome gift which was presented by President Offner on behalf of the Council and Members in recognition of my 20 years service as Secretary of the Society.

All of the Society's progress in its 52nd year could not have been accomplished without the interest of the members, the unselfish service of the officers and Council, and the cooperation of the various committees. In addition I should like to express my thanks to my associates on the staff, who carried the chief burden of the work and made this a year of record accomplishment.

Respectfully submitted,

A. V. Hutchinson, *Secretary*

Dr. B. M. Woods, Berkeley, Calif., first vice president and chairman of the Finance Committee, gave a brief resumé of the financial position of the Society and presented the report of the certified public accountant.

Accountant's Report

Frank G. Tusa & Co.
Certified Public Accountants
52 William Street
New York

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,
51 Madison Avenue,
New York, N. Y.

Gentlemen:

Pursuant to your request, we examined the books of account and records of the American Society of Heating and Ventilating Engineers—New York, N. Y., and the related funds for the fiscal year ended October 31, 1946, and submit herewith our report.

The audit covered a verification of the Assets and Liabilities as of the close of business October 31, 1946. Also, for the fiscal year then ended, we traced the recorded cash receipts into the depositories; we inspected the cancelled bank checks which we compared with the record of cash disbursements; we supported the disbursements by payment vouchers; we accounted for the dues income and interest income from savings accounts and securities.

A Balance Sheet reflecting the financial condition of the Society as of the close of business October 31, 1946, is submitted herewith and your attention is directed to the following comments thereon:

CASH

The Cash on Deposit was verified by direct communication with the commercial and savings banks listed in the schedule of cash included in this report and reconcilement of the amounts reported to us with the respective balances reflected by the books of the Society.

Checks representing the Cash on Hand for deposit were inspected by us and the Petty Cash counted.

MARKETABLE SECURITIES

The securities, shown on the subjoined schedule, were verified by direct communication with the Bankers Trust Company, where same are deposited for safe-keeping. This asset has been included in the Balance Sheet at the cost of acquisition plus the accumulated and accrued interest earned thereon. During 1946 the following securities were sold:

	COST	SALES PRICE	PROFIT OR LOSS
GENERAL FUND			
10M U. S. Savings Bonds, Series "D" of Mar. 1, 1939	$ 7,500.00	$ 7,500.00	—0—
ENDOWMENT FUND			
2M U. S. Treasury Bonds 3⅛%—1949	1,941.46	2,000.00	$58.54
1M U. S. Treasury Bonds 3%—1948	1,024.69	1,000.00	(24.69)
RESERVE FUND			
10M U. S. Savings Bonds, Series "C" of May 1, 1938	7,500.00	7,500.00	—0—
3M U. S. Treasury Bonds 3%—1948	3,074.06	3,000.00	(74.06)
TOTALS	$21,040.21	$21,000.00	$(40.21)

CERTIFICATE OF INDEBTEDNESS

The certificate of indebtedness issued to the Society was verified by inspection of the instrument and the interest accounted for.

ACCOUNTS RECEIVABLE

A trial balance of the membership dues receivable taken as of the close of business October 31, 1946, was classified as to membership and aged as follows:

CLASSIFICATION	AMOUNT
Members	$3,798.00
Associates	3,528.75
Juniors	346.00
Students	6.00
TOTAL	$7,678.75

AGING	AMOUNT
Dues Invoiced during 1946	$6,436.25
Dues Invoiced during 1945	864.50
Dues Invoiced prior years	378.00
TOTAL	$7,678.75

The Miscellaneous Accounts receivable were classified and aged as follows:

CLASSIFICATION	AMOUNT
Guides (Advertising and Copy Sales)	$ 9,222.11
Transactions	94.00
Books and Reprints	558.42
Art and Engravings	68.83
Sundry	185.29
TOTAL	$10,128.65

AGING	AMOUNT
Charges made during October, 1946	$ 8,447.82
Charges made during September and August, 1946	368.28
Charges made during January to June, 1946	918.20
Charges made prior	394.35
TOTAL	$10,128.65

The reserves for doubtful dues and miscellaneous accounts receivable, in our opinion are ample to cover probable losses that might result during realization.

INVENTORIES

The emblems and TRANSACTIONS on hand on October 31, 1946, were counted by us. THE GUIDE paper was verified by direct communication with the printers. All inventories were priced and computed by us. The inventory of TRANSACTIONS follows:

Volume	Year	Quantity	Price	Amount
Prior	Prior	1350	$1.00	$ 1,350.00
46	1940	23	1.25	28.75
47	1941	2	1.32	2.64
48	1942	103	1.42	146.26
49	1943	206	1.39	286.34
50	1944	191	1.82	347.62
TOTAL				$ 2,161.61

EXCHANGES

This account contains amounts due from Council Members for air travel accommodations which were reimbursed prior to the close of this audit.

MORTGAGES RECEIVABLE

The Society holds a mortgage dated November 15, 1945, to which Cyril and Ada R. Tasker are jointly liable to a balance of $7,449.72. This indenture covers premises 3538 Edison Road, County of Cuyahoga, Cleveland Heights, Ohio, is payable in monthly installments of not less than $81.04, including interest and matures on or before November 15, 1955.

PERMANENT ASSETS

On February 21, 1946, the Society purchased from the Order Sons of Italy of America, Grand Lodge of Ohio, premises located at 7218 Euclid Avenue, Cleveland, Ohio, for the sum of $70,000.00. It received a warranty deed to this property which was recorded in Cuyahoga County, Volume 6050, Page 676 on March 21, 1946, No. 3,149,607. This asset has been appraised as follows:

	VALUE	PER CENT
Land	$ 24,000.00	18%
Building	113,000.00	82%
TOTALS	$137,000.00	100%

Depreciation of the building and improvements thereon has been provided for at the annual rate of 2 per cent and furniture and fixtures at 10 per cent.

DEFERRED CHARGES

We have deferred to future income one-sixth of all the subscriptions paid to HPAC since the payment of same is on a calendar year basis and the fiscal year of the Society ends on October 31st, and also, promotion of copy sales applicable to the 1947 GUIDE.

ACCOUNTS PAYABLE

All purchase invoices found on file that were applicable to the operations of the current fiscal period were listed and the proper liability therefor reflected in the attached Balance Sheet.

TAXES WITHHELD

The sum of $423.80 represents Federal Income Taxes withheld from salaries paid to employees during the month of October, 1946.

DEFERRED INCOME

On October 31, 1946, the prepaid dues by elected members were:

Members	$ 725.34
Associates	463.25
Juniors	44.00
Students	15.00
TOTAL	$ 1,247.59

In addition there were dues in the sum of $467.00 prepaid by members proposed for membership.

RESERVE FOR PUBLICATIONS

In accordance with the provisions made in the 1946 budget we have reserved the sum of $5,500.00 to cover the publication of TRANSACTIONS, Vol. 52.

MORTGAGE PAYABLE

Premises located at 7218 Euclid Avenue, Cleveland, Ohio, were purchased subject to a mortgage of $35,000.00 dated February 11, 1946, and payable to the Cleveland Trust Company in quarterly installments of $875.00 each beginning with June 1, 1946. This indenture bears interest at the rate of 4½ per cent per annum payable on each installment date and matures on February 11, 1956. Our verification of this liability was made by direct communication.

Up to October 31, 1946, the following contributions were received which are to be applied towards the reduction of the above mortgage at the direction of the council:

New York Chapter	$634.70
Pittsburgh Chapter	200.00
Heating, Piping and Air Conditioning Contractors National Association	100.00
TOTAL	$934.70

FUNDS

An analysis reflecting the changes that occurred in the following Funds during the fiscal year ended October 31, 1946, is subjoined:

General Fund
Reserve Fund
Endowment Fund
F. Paul Anderson Fund
Mortgage Reduction Fund

INCOME AND EXPENSES

A statement in summary form reflecting the Income and Expenses and comparable items budgeted for the fiscal year ended October 31, 1946, of the Society GUIDE and Research follows:

SOCIETY	ACTUAL	BUDGET
Income	$76,024.04	$ 73,893.00
Expenses	79,618.04	80,425.00
NET OUT-GO	(3,594.00)	(6,532.00)
GUIDE		
Income	85,646.17	59,400.00
Expenses	69,545.60	53,725.00
NET INCOME	16,100.57	5,675.00
RESEARCH		
Income	48,922.49	107,460.00
Expenses	60,702.12	92,870.00
NET INCOME OR OUT-GO	(11,779.63)	14,590.00
TOTAL NET INCOME	$ 726.94	$ 13,733.00
CAPITAL ITEMS		
New Equipment for Research	$ 1,828.60	$ 7,000.00
Initiation Fees to Reserve Fund	7,593.45	4,800.00
Real Estate and Improvements (Cash Disbursed)	49,527.27	—0—
TOTAL	$61,949.32	$ 11,800.00

Respectfully submitted,

Frank G. Tusa & Co.
Certified Public Accountants

Dated January 9, 1947.

BALANCE SHEET

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK, N. Y.

October 31, 1946

ASSETS

GENERAL FUND			
CASH			
On Deposit		$20,786.24	
On Hand for Deposit		5.00	
On Hand		100.00	$20,891.24
INVESTMENTS (AT COST)			
Securities (Market Value $15,495.00)		15,400.00	
ADD: Accumulated Interest	$ 270.00		
ADD: Accrued Interest	105.00	375.00	15,775.00
CERTIFICATE OF INDEBTEDNESS			75.52
ACCOUNTS RECEIVABLE			
Membership Dues		7,678.75	
LESS: 40% for Research	2,930.70		
LESS: Reserve for Doubtful	184.13	3,114.83	
		4,563.92	
Advertising and Sundry Debtors	10,128.65		
LESS: Reserve for Doubtful	112.50	10,016.15	14,580.07
INVENTORIES			
Transactions		2,161.61	
Emblems		295.31	
Guide Paper		7,601.91	10,058.83
EXCHANGES			1,010.68
MORTGAGE RECEIVABLE			7,449.72
PERMANENT			
Land and Building	70,120.80		
Improvements	12,656.59		
	82,777.39		
LESS: Reserve for Depreciation	1,036.66	81,740.73	
Library		300.00	
Furniture and Fixtures	2,943.99		
LESS: Reserve for Depreciation	1,696.41	1,245.58	83,286.31
DEFERRED CHARGES			
Prepaid HPAC Subscriptions		1,534.72	
1947 Guide Copy Sales Promotion		1,243.21	2,777.93 $155,905.30
RESERVE FUND			
Cash on Deposit		6,635.27	
Cash on Hand for Deposit		906.23	7,541.50
Securities at Cost (Market Value $42,458.50)		40,145.00	
ADD: Accumulated Interest		2,313.50	42,458.50 50,000.00
ENDOWMENT FUND			
Cash on Deposit			5,943.42
Securities at Cost (Market Value $20,846.76)		19,039.50	
ADD: Accumulated Interest	1,549.76		
ADD: Accrued Interest	20.00	1,569.76	20,609.26 26,552.68
F. PAUL ANDERSON FUND			
Cash on Deposit		21.68	
Cash on Hand for Deposit		12.50	34.18
Securities at Cost (Market Value $978.00)		1,000.00	
ADD: Accrued Interest		12.50	1,012.50 1,046.68
MORTGAGE REDUCTION FUND			
Cash on Hand for Deposit			934.70
			$234,439.36

LIABILITIES AND FUNDS

GENERAL FUND			
LIABILITIES			
ACCOUNTS PAYABLE		$20,081.30	
FEDERAL WITHHOLDING TAXES		423.80	
ACCRUED ACCOUNTS			
Additional Compensation—Employees		6,074.93	
DEFERRED INCOME			
Prepaid Membership Dues	$ 1,247.59		
LESS: 40% Prepaid to Research	475.44	772.15	
Dues Prepaid by Candidates for Membership		467.00	1,239.15
RESERVE FOR PUBLICATION			
Transactions (1945), Volume 51		251.24	
Transactions (1946), Volume 52		5,500.00	5,751.24
MORTGAGE PAYABLE			
Cleveland Trust Company		33,250.00	
TOTAL LIABILITIES		66,820.42	
GENERAL FUND		89,084.88	$155,905.30
NOTE "A"—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.			
RESERVE FUND			
Principal			$ 50,000.00
ENDOWMENT FUND			
Principal		26,129.20	
Expended Income		423.48	26,552.68
F. PAUL ANDERSON FUND			
Principal		1,033.98	
Unexpended Income		12.70	1,046.68
MORTGAGE REDUCTION FUND			934.70
			$234,439.36

STATEMENT OF INCOME AND EXPENSES

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK, N. Y.

For the Fiscal Year Ended October 31, 1946

INCOME

INCOME FROM MEMBERS			
DUES—RENEWALS			
Members and Associates	$68,562.00		
LESS: Cancellations	1,199.00	$67,363.00	
LESS: 40% to Research Fund		26,945.20	$40,417.80
Juniors and Students		1,332.00	
LESS: Cancellations		33.00	1,299.00 $ 41,716.80
DUES—NEW MEMBERS			
Members and Associates		9,585.00	
LESS: 40% to Research Fund		3,834.00	5,751.00
Juniors and Students			689.50 6,440.50
TOTAL DUES			48,157.30
OTHER INCOME			
Initiation Fees		7,593.45	
Emblems and Certificate Frames		195.44	7,788.89
TOTAL INCOME FROM MEMBERS			55,946.19
INCOME FROM PUBLICATIONS			
Editorial Contract		17,500.00	
Guide Sales and Advertisements—Per Schedule Attached		85,646.17	
Sale of Transactions		850.56	
Income from Books, Reprints, etc.		505.36	
Servicemen's Fees		134.00	104,636.09
INCOME FROM INVESTMENTS			
Interest—Savings Accounts		95.83	
Interest—Securities		730.72	
Interest—Certificates of Indebtedness		1.26	
Interest—Mortgages		260.12	1,087.93
TOTAL INCOME			$161,670.21

EXPENSES

OPERATING EXPENSES

President's Fund	$ 2,002.50	
Council Travel and Meetings	3,029.86	
Membership Committee	1,596.59	
Admissions and Advancement Committee	296.06	
Constitution and By-Laws Committee	13.67	
Nominating Committee	39.22	
Cardex Books to Chapters	77.69	
Chapter Relations Committee and Records	93.73	
Finance Committee	120.13	
Chapter Delegates Travel	3,234.55	
A.S.A. Membership	100.00	
Medals and Awards	426.72	
Membership Certificates	593.01	11,624.13

MEETING EXPENSES

Meetings	2,278.20	
Speakers to Chapters	1,045.32	
Chapter Meeting Allowance	900.00	4,223.52

PUBLICATION EXPENSES

Members' Subscriptions, HPAC	9,038.92	
Guide Publication and Distribution—Per Schedule Attached	69,545.60	
Transactions	8,579.56	
Membership Roll	1,409.00	88,573.08

HEADQUARTER'S EXPENSE

Salaries—Secretary and Staff	31,290.89		
Additional Compensation	6,074.93		
Traveling—Secretary and Staff	1,746.34		
Rent and Light	4,006.29		
Telephone	1,233.38		
Telegraph	334.73		
Postage	2,856.82		
General Printing	932.16		
Office Supplies	682.64		
Addressing and Address Changes	263.72		
Professional Services	1,624.20		
Bank Charges and Foreign Exchange	350.21		
Depreciation of Furniture and Fixtures	278.91		
General Office Expense	1,131.11		
TOTAL HEADQUARTER'S EXPENSE	52,806.33		
LESS: 30% APPLICABLE TO GUIDE	15,841.90	36,964.43	141,385.16
NET INCOME			20,285.05

DEDUCT COUNCIL APPROPRIATIONS

Initiation Fees to Reserve Fund	7,593.45	
Special Appropriation	237.88	
Research Fund-Raising Campaign	7,540.60	15,371.93
EXCESS OF INCOME OVER EXPENSES FOR THE YEAR		$ 4,913.12

BUDGET COMPARISON—SOCIETY ACTIVITIES

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK, N. Y.

For the Fiscal Year Ended October 31, 1946

INCOME

	Actual	Budgeted	Increases	Decreases
MEMBERSHIP INCOME				
DUES—RENEWALS				
100—Members	$ 24,126.00	$ 24,300.00	$	$ 174.00
101—Associates	16,291.80	16,740.00		448.20
102—Juniors	1,287.00	1,750.00		463.00
103—Students	12.00	50.00		38.00
	41,716.80	42,840.00		1,123.20
DUES—NEW MEMBERS				
104—Members	2,076.30	1,200.00	876.30	
105—Associates	3,674.70	1,350.00	2,324.70	
106—Juniors	662.50	375.00	287.50	
107—Students	27.00	25.00	2.00	
	6,440.50	2,950.00	3,490.50	
TOTAL DUES INCOME	$ 48,157.30	$ 45,790.00	$ 3,490.50	$ 1,123.20
OTHER INCOME				
108—Initiation Fees	7,593.45	4,800.00	2,793.45	
109-110—Emblems and Certificate Frames	195.44	1,000.00		804
	7,788.89	5,800.00	2,793.45	804
TOTAL INCOME FROM MEMBERS	55,946.19	51,590.00	6,283.95	1,927
INCOME FROM PUBLICATIONS				
115—Editorial Contract	17,500.00	17,250.00	250.00	
116—Guide Sales and Advertisements	85,646.17	59,400.00	26,246.17	
117—Sale of Transactions	850.56	800.00	50.56	
118—Income from Books, Reprints, etc.	505.36	600.00		94
119—Sales Codes	—0—	—0—		
120—Servicemen's Fees	134.00	400.00		266
	104,636.09	78,450.00	26,546.73	360
INCOME FROM INVESTMENTS				
125—Interest — Savings Accounts	95.83	250.00		154
126—Interest—Securities	730.72	1,000.00		269
127—Interest — Cert. of Indebt.	1.26	3.00		1
Interest—Mortgage	260.12	—0—	260.12	
	1,087.93	1,253.00	260.12	425
COLLECTION OF PRIOR YEAR'S DUES	798.64	2,000.00		1,201
TOTAL INCOME	$162,468.85	$133,293.00	$33,090.80	$ 3,914

EXPENSES

OPERATING EXPENSES

150—President's Fund	2,002.90	2,500.00		497.10
151—Council Travel to Meetings	3,029.86	2,500.00	529.86	
160—Executive Committee	—0—	100.00		100.00
161—Finance Committee	120.13	200.00		79.87
162—Membership Committee	1,596.59	2,000.00		403.41
170—Admission and Adv. Comm.	296.06	500.00		203.94
171—Constitution and By-Laws	13.67	250.00		236.33
172—Nominating Committee	39.22	100.00		60.78
173B—Chapter Delegates Committee	3,234.55	4,000.00		765.45
173C—Chapter Relations	93.73	250.00		156.27
173D—Cardex Books to Chapters	77.69	100.00		22.31
201—A.S.A. Membership	100.00	100.00		
204—Membership Certificates	593.01	200.00	393.01	
206—Medals and Awards	426.72	200.00	226.72	
	11,624.13	13,000.00	1,149.59	2,525.46
MEETING EXPENSES				
163—Meetings	2,278.20	2,500.00		221.80
173A—Speakers to Chapters	1,045.32	1,500.00		454.68
327—Chapter Meeting Allowance	900.00	900.00		
	4,223.52	4,900.00		676.48
PUBLICATION EXPENSES				
200—Members' Subscriptions, HPAC	9,038.92	9,000.00	38.92	
305-326—Guide Publ. and Distrib.	69,545.60	53,725.00	15,820.60	
202—Transactions	8,579.56	4,500.00	4,079.56	
203—Membership Roll	1,409.00	1,500.00		91.00
164—Standards (Including Codes)	—0—	150.00		150.00
207—Publication Comm. Expenses	—0—	—0—		
	88,573.08	68,875.00	19,939.08	241.00

HEADQUARTER'S EXPENSES				
210—Salaries—Secretary and Staff	31,290.89	30,000.00	1,290.89	
211—Additional Compensation	6,074.93	3,000.00	3,074.93	
212—Traveling — Secretary and Staff	1,746.34	1,500.00	246.34	
213—Rent and Light	4,006.29	4,000.00	6.29	
214—Telephone	1,233.38	800.00	433.38	
215—Telegraph	334.73	350.00		15.27
216—Postage	2,856.82	2,500.00	356.82	
217—General Printing	932.16	750.00	182.16	
218—Office Supplies	682.64	750.00		67.36
219—Addressing and Address Changes	263.72	250.00	13.72	
220—Professional Services	1,624.20	1,000.00	624.20	
221—Bank Charges	350.21	100.00	250.21	
222—Depreciation — Furniture and Fixtures	278.91	250.00	28.91	
223—General Office Expenses	1,131.11	1,000.00	131.11	
TOTAL HEADQUARTER'S EXPENSES	52,806.33	46,250.00	6,638.96	82.63
LESS: 30% CHARGE TO GUIDE	15,841.90	13,875.00	1,966.90	
	36,964.43	32,375.00	4,672.06	82.63
INITIATION FEES TO RESERVE FUND	7,593.45		7,593.45	
SECRETARY ANNIVERSARY AWARD	237.88		237.88	
RESEARCH FUND-RAISING CAMPAIGN	7,540.60	15,000.00		7,459.40
IMPROVEMENTS AND MOVING—CLEVELAND LAB.	12,656.59		12,656.59	
TOTAL EXPENDITURES	$169,413.68	$134,150.00	$46,248.65	$10,984.97

President Offner introduced Dr. A. D. Brandt, Bethlehem, Pa., who presented the paper, Nature of Air Flow at Suction Openings, by A. D. Brandt, R. J. Steffy, and R. G. Huebscher (published in the February 1947 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

Discussions of the paper were offered by Messrs. Ralph Poole, London, England, W. N. Witheridge, Detroit, and K. J. Caplan, Lansing, Mich.

W. A. Sherbrooke, New York, chairman of the Board of Tellers, announced the results of the election of officers for the year 1947 as follows:

Tellers of Election Report

BALLOT FOR OFFICERS

	For
President—Baldwin M. Woods	1652
1st Vice President—George L. Tuve	1652
2nd Vice President—A. E. Stacey, Jr.	1652
Treasurer—John F. Collins, Jr.	1651
Members of Council—M. W. Bishop	1642
Carl F. Boester	1642
Leo Hungerford	1646
R. F. Taylor	1649
E. N. McDonnell	1649

Total Ballots Received... 1728
Total Legal Ballots..... 1652

Invalid Ballots—76.
Scattering votes for other candidates.

BALLOT

COMMITTEE ON RESEARCH

R. C. Cross	1642
M. K. Fahnestock	1644
John James	1645
F. J. Kurth	1624
T. H. Urdahl	1627

Total Ballots Received... 1728
Total Legal Ballots..... 1652

Invalid Ballots—76.
Scattering votes for other candidates.

W. T. Jones, Boston, chairman of the Committee on Constitution and By-Laws, presented proposed revisions to the Constitution of the Society and gave a brief resumé of the reasons for the changes which were suggested.

Upon motion of Mr. Jones, duly seconded, it was

VOTED: THAT the revised Constitution be submitted to the membership by letter ballot for adoption in accordance with Art, C-XVI.

The meeting adjourned at noon and members and guests attended a Research Luncheon at Quad Hall, after which inspection trips were made in groups to the Nela Park Lighting Institute and to the American Gas Association Testing Laboratories.

Other events of the afternoon included the opening of the International Heating, Ventilating, and Air Conditioning Exposition at Lakeside Hall, Cleveland, at 2:00 p.m., which was attended by the officers of the Society.

The proceedings of the following sessions will be published in the April JOURNAL SECTION.

TO THE LADIES COMMITTEE

The Ladies Committee may sound like a bore,
But ask the Committee—they'll say it's a chore.
The Ladies Committee—my gosh how they work!
They're stuck with a job they can't decently shirk.

A meeting in prospect not many days hence,
With hordes of incoming ladies and gents;
To feed them and house them and plan for some fun—
Can one poor Committee get it all done?

How many ladies will come with their men?
Will there be hundreds or a handful of ten?
Would a luncheon be nice, or an afternoon tea?—
A scenic tour, or a drive by the sea.

Just what would please all the lady guests—
A shopping spree, or an antique quest?
Can the weather be trusted, or will there be rain?
Suppose it should snow, wouldn't that be a pain!

Meetings, arrangements, telephone calls
To set it all up before THE DAY falls;
Flowers to order, favors to buy,
It's enough to scare off the bravest guy.

So here's a hand to the Ladies Committee
Who groan but must grin in Convention City;
To the man from the chapter chosen as chief
And the ladies selected to share all his grief.

* * *

And now just a hint to the visiting crowd—
Let's deal out some praise and deal it out loud.
In view of their efforts, it would be a pity
To forget our thanks to the Ladies Committee!

JANE SUTTON GREGG,
Bethesda, Md.

SUMMARY OF LOCAL CHAPTER MEETINGS*

CENTRAL OHIO—January 20, 1947. Subject: Panel Heating and Its Control. Speaker: Ferdinand Jehle, director of engineering, Hoffman Specialty Co., Indianapolis, Ind. With the aid of slides Mr. Jehle showed the various types of piping grids used in floor, wall and ceiling panels, pointing out advantages and disadvantages. He also gave a sample calculation to show how such systems were designed and how the design data were used in adjusting a system of modulating control in which circulating water temperature and outdoor temperature were used as the controlling means. His talk was followed by a lively discussion. Attendance 71. Attendance ratio 0.61.

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CINCINNATI—January 7, 1947. Subject: The Free Flow of Air. Speaker: George L. Tuve, second vice president of the ASHVE and professor of mechanical engineering, Case School of Applied Science, Cleveland, Ohio. Professor Tuve prefaced his talk with a discussion of the benefits and personal opportunities offered by membership in the Society. In his technical talk he presented the results of experiments at Case on air flow through various types of outlets. A general discussion followed, after which a rising vote of thanks was extended to Professor Tuve. Other Features: Pres. A. W. Edwards announced that the nominating committee should consist of the last five chapter presidents instead of any five chapter presidents as given in the minutes of the December meeting. W. J. Killian reported on the success of the Christmas party. R. W. Sigmund reported for the membership committee. Attendance 45. Attendance ratio 0.87.

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CONNECTICUT—January 22, 1947. Subject: Furnace Operation and Design. Speaker: Otto de Lorenzi, New York, N. Y. Mr. de Lorenzi illustrated his talk with a technicolor motion picture. Secretary Roeder reported that the expert knowledge of the speaker was reflected in his presentation, which held the close attention of those present. Other Features: The treasurer submitted his report. George Nieske, chairman of the membership committee, reported for his committee. A. J. Lawless reported for the meetings committee that the speaker for the March meeting would be Prof. Carl F. Kayan, assistant professor of mechanical engineering, Columbia University, New York, N. Y. Pres. P. D. Bemis announced the receipt of $526 as contributions to the fund to reduce the mortgage on the Society's Laboratory building in Cleveland, Ohio. Attendance 72. Attendance ratio 0.43.

DELTA—January 10, 1947. Subject: Electronic A Cleaning. Speaker: James W. May, director of researc American Air Filter Co., Louisville, Ky. Upon co pletion of his talk Mr. May invited questions from t floor which led to an interesting discussion. This me ing represented the Chapter's contribution to the Louis ana Engineering Society's annual meeting and the re ular order of business was dispensed with. Atten ance 86.

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INDIANA—January 24, 1947. Subject: Technolog Tomorrow. Speaker: Dr. Baldwin M. Woods, directo University Extension, University of California, Berke ley, Calif., and incoming president of the Society. Dr. Woods gave an excellent presentation which the members thoroughly enjoyed. Other Features: C. F. A. Locke, chairman of the finance committee, reported on the chapter's finances. W. R. Fenstermaker, chairman of the program committee, announced that Carl F. Boester, director of housing research, Purdue University, Lafayette, Ind., would be the speaker at the next meeting. Attendance 53.

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KANSAS CITY—February 3, 1947. Subject: Smoke Abatement. Speaker: Prof. Raymond R. Tucker, head of the department of mechanical engineering, Washington University, St. Louis. Professor Tucker, formerly Smoke Commissioner in St. Louis, told of the various unsuccessful efforts in St. Louis to correct the smoke problems until 1937 when a stringent city ordinance was passed controlling the type of coal that was burned and was later modified in 1940 controlling the type of coal burning equipment. From his talk, Professor Tucker was judged an authority on the subject and did a most creditable job in correcting the smoke problem in St. Louis. Professor Tucker stated that smoke in the city of St. Louis was reduced by 80 per cent and the number of hours of dense smoke was reduced from a previous high of 100 hours per season to a present low of one hour. The interest in Professor Tucker's talk was evidenced by the many questions by the members following the talk. Other Features: Following the approval of the January minutes, Henry Nottberg, Jr., submitted his report as treasurer. E. K. Campbell gave a report on the Smoke Abatement Committee progress. Attendance 57.

KANSAS CITY—January 6, 1947. Subject: Conservation of Natural Gas. Speaker: L. S. Reagan, vice president and general manager, Webster Engineering Co., Tulsa, Okla. Mr. Reagan gave an informal talk dealing primarily with not only the conservation of natural gas, but the installation, operation, adjustment and control of gas burners and factors affecting efficiency of combustion. His talk was enthusiastically received and an active question and answer period followed. Other

*Note. The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Features: E. K. Campbell, chairman of the smoke abatement committee, reported on the progress made by his committee and announced that a subcommittee had been appointed consisting of T. C. Cheasley, N. W. Downes and H. A. Atwater. Attendance 56.

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MANITOBA—January 16, 1947. Subject: General Discussions: Pres. R. E. Moore presided. The minutes of the May, September and November meetings were read and approved. Einar Anderson was appointed Chapter delegate to the Annual Meeting in place of G. E. Dahlgren. Mr. Anderson announced the forthcoming conference of the *Canadian Boiler Manufacturers Association* and the Boiler Inspectors of the provinces of Nova Scotia and Westerly, scheduled to begin January 20. One of the first things on the program, Mr. Anderson stated, was the revising and restandardizing of the Canadian Inter-provincial boiler code.

A discussion took place on the Society's suggestion that funds be solicited from members to reduce the mortgage on the Society's Research Laboratory, Cleveland. F. T. Ball spoke enthusiastically in favor of the Manitoba Chapter assuming its portion of the responsibility and proposed a motion that $100.00 from the Chapter funds be appropriated, and that the secretary circularize the members advising them of this and requesting, where convenient, the sum of $7.00 per member be subscribed. The motion was seconded by Mr. Anderson and unanimously passed. A lengthy discussion followed on chapter meetings and membership. Attendance 14.

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MASSACHUSETTS—January 21, 1947. Subject: The Metro System of Heating as Applied in the Parkchester Housing Project in The Bronx, New York. Speaker: Henry G. Schaefer, vice president, Baker Smith and Co., Inc. The secretary reported on the progress being made toward the fund to reduce the mortgage on the Research Laboratory building in Cleveland. Attendance 60. Attendance ratio 0.80.

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MEMPHIS—January 23, 1947. Subject: Technology Tomorrow. Speaker: Dr. Baldwin M. Woods, first vice president of the ASHVE, and director of University Extension, University of California, Berkeley, Calif. N. C. Ledbetter, vice president of the Chapter, thanked Dr. Woods for his interesting discussion and for his kindness in including the Memphis Chapter in his itinerary. Attendance 31. Attendance ratio 0.82.

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MICHIGAN—January 20, 1947. Subject: Atmospheric Dust Nuisance—What Can We Do About It? Speaker: Henry E. MacComber, mechanical engineer of power plants, Detroit Edison Co., Detroit, Mich. Mr. MacComber's talk was interesting and he impressed his audience with the size of the task ahead in order to rid Detroit and other industrial cities of the smoke and dust nuisance. A rising vote of thanks was given Mr. MacComber. Other Features: The central heating department of the Detroit Edison Co. was host to the Michigan Chapter for the 17th time during the Chapter's history. Following dinner in the Auditorium, Pres. F. R. Bishop turned the meeting over to Mr. Donohoe of the company, who introduced the speaker of the evening. Attendance 142. Attendance ratio 0.96.

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MONTREAL—December 16, 1946. Several letters regarding reducing the mortgage of the Society's Laboratory were read and action was postponed until the January meeting. The 1947 slate of officers was unanimously elected as follows: *President*—Thomas H. Worthington; *Vice President*—Leo Garneau; *Treasurer*—Clifford A. Booth; *Secretary*—S. W. Salter. *Board of Governors:* J. J. Cosgrove, J. P. Fitzsimons, F. J. Friedman, R. R. Noyes and F. G. Phipps. A. B Madden was elected to serve as chapter delegate to the Annual Meeting in Cleveland. Following the business of the meeting, S. W. Salter took charge. Professor *Timmy* (W. W. Timmins) and his 20 questions proved the attraction of the evening. The board of experts comprised of Messrs. Flanagan, Chenevert, Grossman, Hamlet and Worthington were excellent as a jury. Music was provided and some community singing rounded out an enjoyable evening. Attendance 52.

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NEBRASKA—January 14, 1947. Subject: Automatic Control of Radiant Panel Heating and Warm Air Heating. Speaker: J. S. Locke, sales manager of air conditioning and heating controls division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. His talk was accompanied by slides, which were helpful and educational in showing the minimum and maximum of controls required. An interesting discussion followed. Other Features: Henry Kleinkauf, president of the chapter, addressed the meeting on the subject of the purchase of the Society's Research Laboratory, explaining the benefits that the members and the industry were receiving as a result of the research work done at the Laboratory. Attendance 41.

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NEW YORK—January 20, 1947. Subject: The Heat Pump—Its Immediate Possibilities. Speaker: Dr. E. N. Kemler, head, engineering research division, Southern Research Institute, Birmingham, Ala. A lengthy discussion followed Dr. Kemler's talk and a rising vote of thanks was extended to him. Other Features: Floyd Lawrence reported as chairman of the membership committee. President Sherbrooke reported receipt of greetings from R. A. Wasson, Kalamazoo, Mich., former New York Chapter president, who still pays dues to the New York Chapter. The nominating committee was then announced as follows: C. S. Pabst, chairman; Joseph Wheeler, Jr., H. H. Bond, C. S. Koehler and H. J. Ryan. President Sherbrooke then announced that the Board of Governors had approved a gift to the fund for reducing the Laboratory mortgage of $1.00 per member and that the treasurer would send a check for $262.00. Alfred J. Offner, president of the Society, spoke about the progress being made and expressed his confidence that the

New York Chapter would meet its implied quota toward this worthy project. Attendance 136. Attendance ratio 0.24.

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NORTHERN OHIO—January 13, 1947. Following dinner at Quad Hall the members, wives and guests assembled at the Research Laboratory auditorium, where Prof. G. L. Tuve, second vice president of the ASHVE, reviewed the history of the Research Laboratory and its operation by the Society. Don L. Taze, general chairman of the Committee on Arrangements for the Annual Meeting, introduced his committee chairmen and reported that most of the preliminary work had been completed. A letter from Pres. Alfred J. Offner, which further explained and clarified the mortgage retirement plan, was read by Secretary Mannen. Pres. J. E. Wilhelm then asked W. R. Moore for a statement regarding the Northern Ohio Chapter's contribution to the fund. The members were pleased to learn that $1257.00 had been pledged to date. Cyril Tasker, director of research for the Society, welcomed the members and guests at the Laboratory and thanked the chapter members for their help. Mr. Tasker stressed the necessity of providing basic information from research, reducing factors of safety and coordinating THE GUIDE with research discoveries. Clyde A. McKeeman, assistant to the president of the Society, reviewed the promotional work being done to keep industries informed of their responsibility in assisting the Society to maintain the Laboratory.

The ladies adjourned to the conference room for a special meeting and Mr. Tasker then introduced the senior engineers, C. M. Humphreys, H. B. Nottage and G. V. Parmelee. Their talks covered the various projects on which they are now conducting research. The members and guests then inspected the various test stands set up throughout the Laboratory and the meeting adjourned at 10:45 p.m. Attendance 147. Attendance ratio 1.02.

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OKLAHOMA—January 13, 1947. Subject: Fluid Drives as Applied to Industry. Speaker: Carl Clegg, district manager, American Blower Corp., Kansas City, Mo. General discussion followed Mr. Clegg's interesting talk. Attendance 28.

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ONTARIO—February 3, 1947. Subjects: Radiant Heating; Research in Heating and Ventilating in England. Speakers: Mark Jackson and Ralph Poole, London, England. Other Features: A. S. Morgan reported on the Chapter Delegates meeting at the Annual Meeting. Attendance 72. Attendance ratio 0.29.

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OREGON—January 9, 1947. Subject: Electric Precipitation Method of Air Cleaning. Speaker: Walter A. Simpson, vice president, R. E. Chase and Co., Portland, Ore. Mr. Simpson explained with blackboard illustrations the operations and proper installation of the electric precipitation method of air cleaning. Special examples were given pertaining to results obtained in food plants for the control of mold and mildew. Other Features: T. H. McClung reported as chairman of the membership committee. Pres. W. Bruce Morrison announced the plans for the Oregon Chapter to help reduce the mortgage on the Society's Research Laboratory building in Cleveland. Attendance 58.

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PACIFIC NORTHWEST—January 14, 1947. Business Session: Pres. R. E. LeRiche presided, and after the introduction of guests D. C. Griffin, secretary of the chapter, read a letter from the headquarters office regarding the voluntary contributions by members for the reduction of the mortgage on the Society's Research Laboratory. After some discussion it was moved that no action be taken until the chapter delegate returns from the Annual Meeting in Cleveland. The motion was unanimously passed. E. H. Langdon read the proposed changes in the Society's Constitution and By-Laws. C. W. May gave a summary of the activities of the Puget Sound Engineering Council, dealing particularly with the various phases of the proposed revisions to the Engineers license law. Mr. Griffin gave a report on the committee's recommendations on Code revisions, insofar as heating, ventilating, air conditioning and refrigeration matters are concerned.

PACIFIC NORTHWEST—December 10, 1946. The meeting was highlighted by a humorous unrehearsed skit on the pitfalls encountered by a prospective client requesting an architect to design him a low priced home. President LeRiche presided at this annual holiday meeting. Attendance 43.

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PITTSBURGH—January 13, 1947. Subject: Smoke Ordinance No. 344 for Pittsburgh. Speaker: Henry F. Hebley, director of research, Pittsburgh Coal Co. He gave a general discussion of the reasons why the smoke and fog are general over Pittsburgh. He showed slides which gave the locations of the blast furnaces and rolling mills around the city of Pittsburgh. An interesting discussion followed. Attendance 44. Attendance ratio 0.51.

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ST. LOUIS—January 7, 1947. Subject: Control of Radiant Panel Heating, Including Hot Water and Warm Air. Speaker: John E. Haines, vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., and president of the Minnesota Chapter of ASHVE. Mr. Haines presented his subject well and proved to be an interesting and well informed speaker on the subject. A period of discussion followed with the usual interest being shown. Other Features: J. S. Rosebrough reported on the Chapter's finances. George Myers was appointed Chapter Delegate and B. C. Evans as alternate to the Annual Meeting. Treasurer Rosebrough was requested to turn over the funds raised to help pay off the mortgage on the Society's Research Laboratory building

to Mr. Myers so that he could deliver the funds amounting to $225 when he arrived in Cleveland. Attendance 140.

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SOUTH TEXAS—January 17, 1947. Safety Building Code (Los Angeles). Speaker: Art Theobald, research engineer, Payne Furnace Co., Beverly Hills, Calif. An ovation was given Mr. Theobald at the conclusion of his talk. Mr. Theobald extended an invitation to the Chapter to attend the Semi-Annual Meeting of the Society scheduled for June 2-4, 1947, at Coronado, Calif. Other Features: A. J. Natkin brought out a discussion on design of laying out jobs pertaining to safety and fire hazards. A. F. Barnes reported on the Engineers Council Meeting. Discussion followed on the plan to help reduce the mortgage of the Society's Laboratory building, Cleveland. L. L. Ladewig, treasurer, submitted his report. Attendance 91.

The attendance previously reported for the October and November meetings of the South Texas Chapter was incorrectly given. The attendance should have been reported as 62 for October and 65 for November, showing an ever increasing attendance at monthly meetings.

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SOUTHERN CALIFORNIA—January 8, 1947. Subject: Engineering Problems Encountered with Heating, Ventilating and Air Conditioning Equipment in a Major Movie Studio. Speaker: John L. Blake, chief engineer, air conditioning department, M. G. M. Studios. Mr. Blake briefly discussed the difficulties encountered in maintaining equipment during the studio labor strike. The labor situation demanded that a more systematic method be devised for maintaining equipment. The M. G. M., Mr. Blake explained, was zoned and a man was placed in charge of all equipment in each zone. Strict records were kept of maintenance history. A general maintenance crew was used on general maintenance work around the studios. He further explained that a great many of the ventilation problems in major studios are centered in the film processing laboratories. Because of the great value of the film being processed, he stated, that all dirt must be entirely dispensed with. This is a very difficult proposition and Mr. Blake described some of the problems he has been faced with in eliminating the dirt. In his general remarks on technicolor stages, Mr. Blake mentioned that there was three times the heat load for technicolor as for black and white. He stated that a technicolor sound stage normally had a lamp load of 10,000,000 Btu per hour and used 400 people. He concluded by giving some interesting suggestions to designers of ventilating systems for movie studios. An interesting discussion followed. Other Features: J. S. Earhart discussed the ramifications of local contributions to retire the mortgage on the Society's Research Laboratory building in Cleveland. Art Theobald gave a history of actions leading to the Semi-Annual Meeting scheduled for the Del Coronado Hotel, Coronado, Calif. Attendance 48.

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UTAH—January 8, 1947. Subject: Utilization of Fuel Oil in Heating Equipment. Speaker: Gordon I. Kirby, fuel oil department, Consumers Div., Utah Oil Refining Co. Mr. Kirby described the grades of fuel oil in common use, outlined the specifications of each and noted their fields of application. He explained that No. 1 fuel oil is usually recommended for pot type burners, whereas No. 3 fuel oil, he stated, is satisfactory for mechanical burners. Other Features: Following Mr. Kirby's talk, C. E. Murdock, chairman of the program committee, announced an added feature, the showing of a motion picture entitled *Eternally Yours*, which showed the process of manufacturing wrought iron pipe. This was shown through the courtesy of A. M. Byers Co. The following were elected to serve on the nominating committee: H. G. Richardson, C. E. Murdock, R. H. East, R. J. Fairclough and C. H. Spencer. Pres. J. T. Young, Jr., announced that Farragut College and Technical Institute is looking for personnel with practical experience in their fields, and advised the members interested in joining the faculty in one of the vacancies to contact the president of the college. Attendance 18. Attendance ratio 0.35.

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WASHINGTON, D. C.—January 8, 1947. Subject: Air Distribution Through Perforated Plates and Panels. Speaker: M. J. Stevenson, consulting engineer, Chicago, Ill. An interesting discussion followed Mr. Stevenson's talk. Attendance 105. Attendance ratio 0.50.

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WESTERN NEW YORK—January 13, 1947. Subject: Background and Application of Unit Ventilators. Speaker: G. E. Otis, vice president, Herman Nelson Co. Many questions were asked and Mr. Otis provided answers based upon his vast knowledge and many years of study of his topic. Attendance 40.

WESTERN NEW YORK—December 18, 1946. Christmas Party. Minutes and business were dispensed with. Bridge and bowling were well patronized before the formal meeting, which was called to order by Pres. Herman Seelbach, Jr. A buffet luncheon was served.

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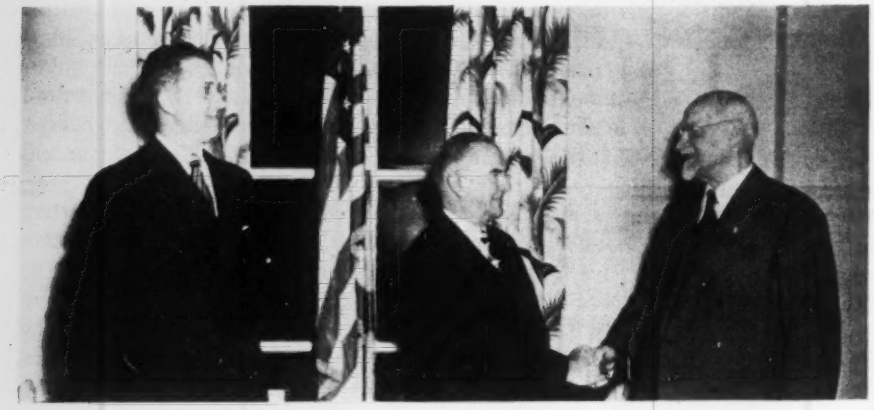
WISCONSIN—January 13, 1947. Subject: Practical Application of Radiant Panel Heating and Control Thereof. Speaker: Ferdinand Jehle, director of engineering, Hoffman Specialty Co., Indianapolis, Ind. Mr. Jehle indicated that all heat loss calculations for a space or building could be calculated on the same basis as for other types of heating systems. He indicated that selections of panels, that is, in walls, ceilings or floors, were governed by the type of room or building to be heated as well as the structural features which might dictate the proper location. Mr. Jehle answered the many questions put to him in the discussion that followed. A rising vote of thanks was extended to the speaker. Other Features: J. R. Vernon gave a brief treasurer's report. In the absence of M. W. Bishop, program chairman, Mr. Vernon announced a joint meeting with the Engineers' Society of Milwaukee. Attendance 60.



Homer Addams is congratulated by George H. Campbell, a leading citizen of Oswego, N. Y., while his son, Paul K. Addams (left) looks on

HOMER ADDAMS HONORED

On the 60th anniversary of the organization of the Fitzgibbons Boiler Co., Inc., and the 25th anniversary under the direction of Homer Addams, he and his associates were honored at receptions and dinners held both in New York City and in Oswego, N. Y.

Mr. Addams, charter member and past president and treasurer of the ASHVE, was presented with a diamond studded emblem in recognition of more than 35 years of steel boiler sales and manufacturing in the New York area. He became president of Fitzgibbons in 1921 and is now president and chairman of the board of directors of the company.

Mr. Addams was born in Addamstown, Pa., where he spent his early boyhood, and at the age of 15 he became a helper installing steel boilers and heating plants. In 1895 his engineering education qualified him for a position as engineer in charge of construction for the heating firm of Barber and Ross, Washington, D. C. The next year he became associated with a Philadelphia cast iron boiler manufacturer.

In 1903 he became a special representative in Washington, D. C., on government projects and problems for the Kewanee Boiler Co. of Illinois, and in 1905 became the assistant secretary of the Model Heating Co., Philadelphia and New York. He later was appointed secretary of Fowler and Wolfe, Philadelphia, Pa., and in 1911 he was appointed Eastern manager of the Kewanee Boiler Co., Kewanee, Ill. In 1920 he formed the Kewanee Boiler Co., Inc., of New York, becoming its president in 1921. Soon after that he acquired the Fitzgibbons Boiler Co. and during his 25 years as president, the company expanded rapidly in the heating and air conditioning fields. Under Mr. Addams' direction the company went on a full war production basis from 1941 to 1945.

Paul K. Addams, executive vice president and treasurer, has been with the company for 17 years, and was among others honored for his years of service. Others who received special recognition during the company's 60th anniversary celebration were: John A. Darts and G. E. Olsen, vice presidents with the company for 35 and 33 years, respectively; Elizabeth K. West, James F. Swartz, O. F. Noss, E. N. Black, III, H. O. Beadle and Rudy Wickel, all of whom were with the company over 20 years, and Ray C. Malvin, vice president and general plant manager, with the company for 16 years. A total of 92 Oswego plant employees who had put in more than 16 years of service were presented with emblems in appreciation of their service.

Mr. Addams, a prominent figure in ASHVE activities, is also a Life Member of the Society, served as president in 1924 and as Treasurer from 1915 to 1922, and as a member of the Council from 1915 to 1925. He is also a member of the *ASME*, a past president of the *Steel Boiler Institute*, a member of the Engineers Club of New York, the City Club, Oswego, N. Y., and F. and A. M., Greenleaf Lodge No. 561, Allentown, Pa.

W. W. TIMMIS IN NEW POST

W. Walter Timmis has been appointed general sales manager for Consolidated Industries, Inc., Lafayette, Ind. Mr. Timmis, widely known in the heating and air conditioning industry, served as director of the Metal Products Division of the National Housing Agency, a position he was asked to fill because of his comprehensive experience with the Plumbing and Heating Division of the War Production Board, of which he was appointed director in the early part of 1942. Mr. Timmis is credited with an extraordinarily successful wartime job in originating the policies and procedures of that crucially important organization.

In the fall of 1942, Mr. Timmis was commissioned a Commander by the U. S. Navy and was given charge of production at the naval torpedo station at Alexandria, Va.

Prior to his wartime experience, Mr. Timmis had almost 20 years' experience in the heating and air conditioning industry, serving as manager of M. E. Conran Co., as manager of C. A. Dunham Co., New York office, and as manager of the Air Conditioning Systems and Controls Division, American Radiator Co.

In 1938 he became president of the Au-Temp-Co Corp., and later organized Herske and Timmis, Inc., New York, which he served as vice president until his call to government service.

A graduate of Swarthmore College, Mr. Timmis is the holder of numerous patents for controls and valves for heating and air conditioning equipment.

He joined the ASHVE as an associate member in 1925 and was elected a full member in 1933. In 1935-36 he served as president of the New York Chapter.

W. W. Timmis

7TH INTERNATIONAL HEATING AND VENTILATING EXPOSITION

The first post-war Heating and Ventilating Exposition, held in Cleveland's Lakeside Hall, January 27-31, 1947, was the largest ever held and demonstrated the importance of this event in the industry embracing all phases of heating, ventilating, and air conditioning. It was a stimulating, and in many ways an arresting, display releasing the pent-up results of seven years' industrial repression. Many significant innovations were featured, but this first post-war exposition as a whole was comprehensive and well balanced, representing the products of a highly diversified industrial group with strongly progressive tendencies. Visitors registered during the week numbered 30,561.

A multiplicity of inventions contributed to make the Exposition the most widely assorted, as well as the largest of its kind. These exemplified every method that has yet been devised for making the indoor climate more wholesome and livable, easily, simply and with improved economy.

At a meeting held in Cleveland the Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS concluded that the industry will be introducing more new products than ever during the next year and that, therefore, an Exposition should be held in connection with the next annual meeting in New York City, February 2-6, 1948. It was also indicated that this annual schedule of exposition in conjunction with the Annual Meeting is planned to be continued until 1950.

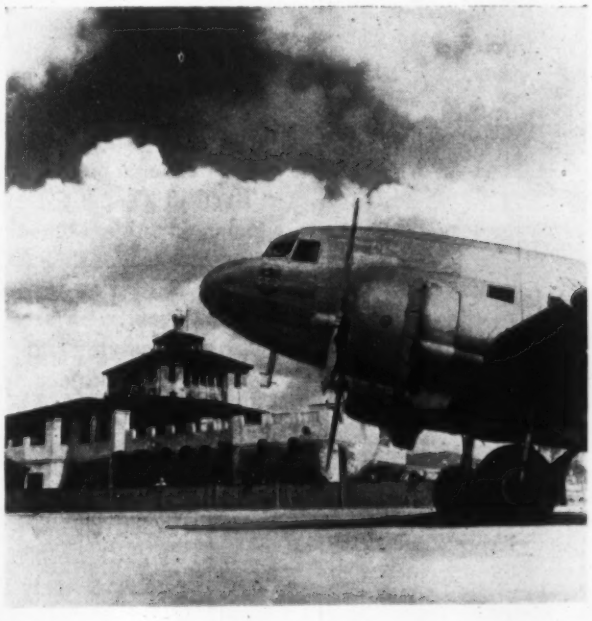
SUNSHINE AND THE SEA FOR SEMI-ANNUAL MEETING

CORONADO CALLS — **JUNE 2-4, 1947**

THE invitation of the Southern California Chapter to act as hosts for the Semi-Annual Meeting 1947 was accepted with pleasure by the Council and a three-day meeting, June 2 to 4, will be held at the Hotel del Coronado, Coronado, Calif.

Three Technical Sessions are planned at which nine papers will be presented. President Art Theobald, of the Southern California Chapter, has announced the appointment of Robert A. Lowe as General Chairman of the Committee on Arrangements and his sub-committees are planning a program of entertainment that will appeal to everyone.

Coronado is an area that is celebrated for its delightful uniformity of climate and is located just across the Bay from San Diego. It is reached by two railroads and also has fine motor highways, as well as service by airlines and motor bus. The Mexican border is 18 miles distant and this area of Southern California abounds in historic interest.



Hotel del Coronado overlooks the Pacific Ocean on one side and the broad expanse of San Diego Bay on the other. The hotel operates under the American Plan and room and meals are covered by the following rates: twin bedroom with bath, (two persons) $20.00; single room with bath, $11.00 and $12.00 per person per day.

There is a variety of accommodations and the following types of rooms are available: single rooms with bath (very limited); single rooms with bath between; twin bedrooms and bath; twin bedrooms with bath and sun porch; twin bedrooms with single room and bath connecting; two double rooms with bath connecting.

For the sports enthusiast there are golf at the Coronado Country Club (nine hole course), tennis courts of championship quality, a swimming pool, horseback riding and sailing.

For the fishermen Coronado waters provide many varieties of game fish during the season (May to October).

The Local Arrangements Committee promises a trip into Old Mexico with its surrounding country which is rich in romantic and historic interest as well as scenic beauty. A golf meet will feature

one afternoon and play will be resumed for the Research and Eichberg Cups. There will be fun for everyone at the Semi-Annual Meeting 1947.

Coronado is served via San Diego from Los Angeles and from the north and east by the Santa Fe Railroad, from Arizona and the south and east by the Southern Pacific Railroad. Plans are being made for an eastern group of members to have a special train which will afford an opportunity for many to combine a vacation trip with their attendance at the meeting. The route, the schedule, and the cost will be announced shortly. Frequent airline service is provided by American Airlines, United Air Lines and Western Air Lines.

California calls and ASHVE members respond, "Coronado, here we come!"

W. T. REID JOINS BATTELLE

William T. Reid, associated with the U. S. Bureau of Mines for 17 years, has joined the staff of Battelle Memorial Institute, Columbus, Ohio, where he will be engaged in the supervision of research in fuels and combustion.

Mr. Reid, well known for his research on the utilization of solid fuels and on the properties of coal-ash slags at high temperatures, holds a B.S. degree in chemical engineering from the University of Washington. He also studied at the Carnegie Institute of Technology and the University of Pittsburgh. At the time of his appointment he was supervising engineer of the Combustion Research Section of the Bureau of Mines.

He is active in the work of technical societies, serving as a member of the Special *ASME* Research Committee on Furnace Performance Factors as well as a member of its Design Committee of the Industrial Instrument and Regulators Division. He is also a member of the *ASME* Committee on a Code for Testing Coal and the Committee on Testing Technique of the Heat Transfer Division of the *ASME*, and a member of the ASHVE's Technical Advisory Committee on Fuels and of the Subcommittee XVI of Committee D-5 on Reactivity of Solid Fuels of the *American Society for Testing Materials*.

During the major portion of 1946, he served on the staff of the National Resources Section of GHQ, Supreme Commander of Allied Powers, in Japan, as a scientific consultant on fuels. He is the author of numerous technical papers which have been published in the *ASME Transactions*, the Bureau of Mines publications, and has contributed to other scientific and engineering journals. Mr. Reid is a registered engineer in Pennsylvania.

F. C. BRANDT RECEIVES NEW POST

Frederick C. Brandt has been appointed sales manager of the air conditioning controls division for the Minneapolis-Honeywell Regulator Co. in the southwestern region as announced by J. E. Haines, vice president of the company.

Mr. Brandt will make his headquarters in Houston at the company's regional office, 1309 Capitol Ave. He was born at Pittsburgh, Pa., and received his degree in mechanical engineering from the University of Minnesota in 1934. He joined Minneapolis-Honeywell in 1936 and spent two years in the sales department in the Minneapolis headquarters office. He also was assigned to the Chicago office for two years and for the past seven years has been serving as sales engineer in the air conditioning controls division in Houston.

H. P. REID PROMOTED

Henry P. Reid, assistant to president, Universal Atlas Cement Co., United States Steel Corp. subsidiary, has been appointed chief engineer of the company, according to a recent announcement from Blaine S. Smith, president. Mr. Reid succeeds the late Richard A. Dittmar.

Mr. Reid, for the past 23 years, has served successively as special engineer, operating engineer, and since 1942, as assistant to the president. He has directed many developments in rotary kiln operations, fuel economy as well as dust control and collection, in his engineering and research work for the company's cement plants.

Born in Tennent, N. J., Mr. Reid attended public school there and after his graduation from the New Jersey Military Academy he entered Cornell University, Ithaca, N. Y., receiving his degree in mechanical engineering in 1911. Following his graduation from Cornell he served for six years in Siam as technical missionary for the Board of Foreign Missions, Presbyterian Church of the United States. Upon his return to America he worked successively as a produc-

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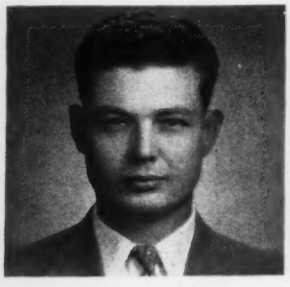
Secretary-Treasurer



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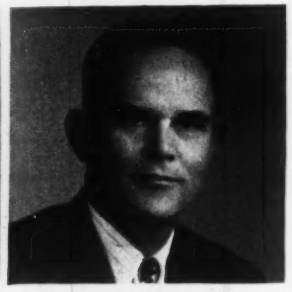

J. S. Hopper

Board of Directors

tion engineer for Bethlehem Shipbuilding Co., Sparrows Point, Md., and as instructor at J. S. Morton High School, Cicero, Ill. He joined the Universal Atlas Cement Co. in 1924.

He has written many technical articles for the cement industry and is chairman of the chemical technical committee of the *Portland Cement Association*. He joined the ASHVE in 1927 as an associate member and in 1931 was elected to full membership. He is also a member of the *ASME*.

W. V. REYNOLDS DIES

Word has been received of the death of Walter V. Reynolds, president, Walter Reynolds, Inc., New York, N. Y., on January 6, 1947. He was born on June 15, 1881, in New York City, attended Columbia University and took a two year scientific course at the College of the City of New York. He held the rank of Captain in the U. S. Army.

In 1912 he became superintendent and general manager of Arthur Janes Co., which position he held until 1922, when he became president of the firm Janes-Reynolds Co., Inc., New York. All the technical work pertaining to construction was under his direct supervision. He was responsible for various ventilation installations done for the Equitable Office Building Corp., the Mutual Life Insurance Building, F. W. Woolworth Co. properties in the metropolitan district in New York, various boiler installations in the Park Department buildings, and for various heating installations in private residences in and around New York City.

He was elected to associate membership in the Society in 1928. The Officers and Council of the Society extend their sincere sympathy to his family.

R. C. MORGAN DIES IN 74TH YEAR

Robert C. Morgan, Life Member of the Society and chairman of the board of Stewart A. Jellett Co., Philadelphia, died at his home on January 30, 1947, in his 74th year. Mr. Morgan attended the Heacock School and was graduated from the University of Pennsylvania in 1893.

He began his career as a mechanical engineer in that same year when he joined the staff of Francis Brothers and Jellett, predecessor of the present firm, of which he was a former president.

Mr. Morgan was in complete charge of designing the mechanical equipment for many large institutions, hotels, schools and hospitals, including the Ansonia Hotel, New York, the Bellevue-Stratford, Lit Brothers and the John Wanamaker stores, Germantown Hospital, the Delaware County Court House, Media, and the Reading, Danville and Norristown State Hospitals.

Mr. Morgan joined the ASHVE in 1915 and was elected to Life Membership in 1943. He was active in Society affairs and in the activities of the Philadelphia Chapter and will be missed by his many friends and associates in the heating and ventilating profession.

He was also a member of the *American Society of Mechanical Engineers*, the Philadelphia Engineers' Club, Military Order of the Loyal Legion and the Westside Presbyterian Church, and was a Mason.

He is survived by his wife, Mrs. Alberta S. Morgan, two sons, Joseph Morgan, Philadelphia, and Andrew S. Morgan, Bethlehem, a daughter, Mrs. Frances M. Harting, Philadelphia, and a sister, Mrs. Ellen M. Marshall, Palo Alto, Calif., to whom the Officers and Council of the Society extend their deepest sympathy.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 80 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 25, 1947, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ARONOFF, MELVIN S., Design Engr., Herman Blum. PROPOSERS: Herman Blum, Marvin Gardner. SECONDERS: J. D. Poythress, J. A. Ray.

ASHFORD, FRED, JR., Student, Texas A & M College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

BAKER, DONALD L., Engr., Carrier Corp. PROPOSERS: Margaret Ingels, H. G. Strong. SECONDERS: W. G. Hillen, T. M. Cunningham. (*Advancement*)

BALDWIN, CHARLES W., Vent. Engr., U. S. Rubber Co. PROPOSERS: Winfield Roeder, W. E. Heibel. SECONDERS: W. L. Fleisher, P. F. McNally (*Advancement*)

BARDO, FREDERICK J. Jr., designer, Beman & Candee. PROPOSERS: M. C. Beman, B. C. Candee. SECONDERS: D. J. Mahoney, E. H. Cox.

BARSHA, NICHOLAS B., Chief Engr., Airtherm Manufacturing Co. PROPOSERS: R. H. Metcalf, H. C. Sharp. SECONDERS: W. A. Klein, R. H. Kremer.

BILLINGTON, DAN B., Sales Engr., A. L. Vanderhoof, Inc. PROPOSERS: J. A. Hall, M. R. Hamlin. SECONDERS: F. C. Richardson, Jr., R. L. Byers.

BROBECK, ROY A., Htg. & Vent. Engr., B. F. Shearer Co. PROPOSERS: E. H. Langdon, D. C. Griffin. SECONDERS: M. W. McKinstry, R. E. LeRiche.

BROUSSARD, DOUGLAS E., Student, Texas A & M College. PROPOSERS: J. S. Hopper, W. E. Long. SECONDERS: Carl Files, C. W. Crawford.

CAIN, JAMES A., Div. Mgr., A. M. Byers Co. PROPOSERS: A. L. Lindstrom, W. J. McKinney. SECONDERS: H. K. McCain, F. W. Bull.

CARLSON, RICHARD M., Engr., Pfeifer & Shultz. PROPOSERS: A. B. Algren, F. B. Rowley. SECONDERS: B. F. McLouth, O. L. Lilja.

CLAR, ROBERT, JR., Htg. & Piping Engr., Murray W. Sales & Co. PROPOSERS: R. K. Milward, A. E. Knibb. SECONDERS: W. H. Old, W. C. Randall. (*Reinstatement & Advancement*)

COLLINS, WILLIAM A., JR., Student, Texas A & M College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: C. W. Crawford, Carl Files.

COUCH, HENRY J., Engr., Air Filter & Equipment Co. PROPOSERS: J. H. Milliken, J. W. May. SECONDERS: C. E. Price, C. M. Burnam, Jr.

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FLAGG, LOUIS F., Sales Engr., Minneapolis-Honeywell Regulator Co. PROPOSERS: F. M. Thuney, M. F. Hoppe. SECONDERS: J. W. Markert, A. E. Beitzell.

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GOETHE, SAM P., Research Engr., Florida Engineering & Industrial Experiment Station. PROPOSERS: J. J. O'Shea, W. J. McKinney. SECONDERS: N. C. Ebaugh*, Joseph Weil*.

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HARRIGAN, PAUL D., Cons. Engr., Harrigan-Hill. PROPOSERS: J. R. Howard, Winfield Roeder. SECONDERS: C. W. Freeman, S. R. Qsborne.

HART, JAMES E., Partner, Watson & Hart. PROPOSERS: C. Z. Adams, R. K. Hunter. SECONDERS: W. D. Graham, Harry Hoffman.

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HOYLER, THOMAS H., Student, Texas A & M College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

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MCNAMARA, GEORGE Q., Mfrs. Agent, George Q. McNamara, Inc. PROPOSERS: W. H. Old, F. R. Bishop. SECONDERS: L. A. Burch, T. H. Mabley.

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SCHIMPKE, BURTON J., Student, Michigan State College. PROPOSERS: C. H. Pesterfield, L. G. Miller. SECONDERS: K. E. Robinson, K. J. Caplan.

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SMITH, ALBERT M., Htg., Vent. & Air Cond. Designer, RCA Manufacturing Co. PROPOSERS: E. R. Robinson, R. S. Mizener. SECONDERS: J. O. Kirkbride, H. M. Parent.

SMITH, EDWARD O., Asst. Mgr., Eastern Gas & Fuel Associates. PROPOSERS: C. E. Shaffer, K. C. Richmond. SECONDERS: H. J. Rose, R. A. Sherman.

SPANTON, MILTON D., Mgr., Plbg. & Htg. Dept., Coast-to-Coast Stores. PROPOSERS: A. B. Algren, H. C. Mills. SECONDERS: B. F. McLouth, J. E. Haines.

SPERRY, HARVEY A., Steam & Hot Water Htg. Inspector, City of Minneapolis. PROPOSERS: L. K. Reisberg, L. C. Hanson. SECONDERS: A. F. Hovda, A. B. Algren.

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WARNECKE, ROBERT I., Chief Engr., Roberts-Gordon Appliance Corp. PROPOSERS: K. T. Davis, J. N. Crawford. SECONDERS: L. C. Harvey, W. R. Teller.

WEISNER, CLARENCE E., Mech. Engr. PROPOSERS: E. R. Clement, G. F. Nieske. SECONDERS: H. J. Blakeley, R. M. Toucey.

*Non-member.

CANDIDATES ELECTED

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by **Art. B-III**, *Section* 8, of the By-Laws, the following list of candidates elected:

Members

ANDERSON, GEORGE A. M., Pres., The King Co., Owatonna, Minn. (*Advancement*)

BARNES, JOHN G., JR., Engr., Natkin & Co., Kansas City, Mo.

BLAIR, DONALD W., Mech. Designer, Stone & Webster Engineering Corp., Boston, Mass. (*Advancement*)

DAVIS, CLYDE W., Owner, C. W. Davis Plumbing & Heating, Huntington, W. Va.

DYE, O. E. F., Asst. Chief Mech. Engr., Commonwealth Department of Works, Sydney, N. S. Wales.

EDGARTON, LEWIS S., Prof. Engr., Nantucket, Mass.

GREENBERG, BENJAMIN F., Engr., A. A. Duckett, Inc., Camden, N. J.

GRIECO, ALFONSO V., Chief Draftsman, Carrier Corp., New York, N. Y.

HAUSLER, WALTER, Owner & Mgr., Institute of Heat Economy, Zurich, Switzerland.

HENTON, L. W. J., Htg. & Vent. Supt., Gaumont British Picture Corp., Ltd., London, England.

HILL, EDWARD, JR., Cons. Mech. Engr., Franklin, Kump & Falk, San Francisco, Calif. (*Advancement*)

HORSBURGH, BALFOUR J., Branch Mgr., Johnson Service Co., Montreal, Que., Canada. (*Advancement*)

JACKSON, JOSEPH S., Indus. Engr., United Engineers & Constructors, Inc., Philadelphia, Pa. (*Advancement*)

KRESH, STANLEY, Engr., & Vice-Pres., Jas. H. Martin, Inc., New York, N. Y.

LOVE, J. EDWIN, Plant Engr., RCA Victor Division, Camden, N. J.

MARTIN, KENNETH E., Branch Mgr., American Blower Corp., Omaha, Nebr.

MOORHEAD, ROBERT C., Engr., Findlay, Ohio.

MORRISON, W. BRUCE, Cons. Engr., Portland, Ore. (*Advancement*)

NELSON, ARTHUR N., Mech. Engr., Monroe Bowman & Associates, Chicago, Ill.

NYE, L. BERT, JR., Staff Engr., Washington Gas Light Co., Washington, D. C. (*Advancement*)

PIERCE, CONWAY, Mech. Engr., Detroit, Mich.

POSPISIL, PHILIP J., Field Engr., The Trane Co., Omaha, Nebr.

QUEENIN, MARTIN A., Engr., Edward E. Ashley, New York, N. Y.

REDMILE, HARRY W., Cons. Engr., Washington, D. C.

ROBINSON, DONALD M., Engrg. Repr., Buffalo Forge Co., Houston, Texas. (*Advancement*)

SHATALOFF, NICHOLAS S., Engr., Buensod-Stacey, Inc., New York, N. Y.

SHELDON, HERBERT P., Vice-Pres., Harry F. Haldeman, Inc., Los Angeles, Calif.

SHEPPERD, W. B., Oklahoma A & M College, Stillwater, Okla.

SHOEMAKER, RICHARD W., Cons. Engr., Chase Brass & Copper Co., Waterbury, Conn.

SPENCER, SCOTT A., Engr., Edward E. Ashley, New York, N. Y.

VANDERWEIL, R. G., Project Engr., Chase Brass & Copper Co., Waterbury, Conn.

VARMING, JORGEN, Cons. Engr., Steensen & Varming, Copenhagen, Denmark.

WARE, JOSEPH H., JR., Engr., Southern Bell Telephone & Telegraph Co., Atlanta, Ga.

WOOLCOCK, EDWIN, Owner, Woolcock Plumbing & Heating Co., Niagara Falls, N. Y. (*Advancement*)

WURTS, HENRY H., Designer, Manhattan Blower Corp., Brooklyn, N. Y.

Associate Members

ABENDROTH, HAROLD F., Temp. Control Sales Engr., Johnson Service Co., Chicago, Ill.

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BEVAN, JOHN H., Draftsman, Trane Company of Canada, Ltd., Toronto, Ont., Canada.

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BROWN, WILLIAM L., JR., Partner, Brown Bros., Durham, N. C. (*Reinstatement*)

CAMPBELL, SIMON, Draftsman, Musgraves & Co. (Dublin) Ltd., Dublin, Ireland.
CLINE, CARL C., Owner, Southern Refrigeration Co., Dallas, Texas.
CORR, FRANK J., Engr. & Partner, Air-Flo Heating Co., Seattle, Wash.

DALY, JOHN D., Sales Engr., A. F. Hinrichsen, Inc., New York, N. Y.
DARLING, JOHN W., Sales Engr., Ontario Plumbing & Heating Supplies, Ltd., Toronto, Ont., Canada.
DELANY, WILLIAM F., Chief Draftsman, Trane Company of Canada, Ltd., Toronto, Ont., Canada.
DILL, EDWARD F., Sales Engr., Minneapolis-Honeywell Regulator Co., San Francisco, Calif.

ENDO, HIDEO, Mech. Engr., R. E. Hattis, Chicago, Ill.

FAUST, HAROLD G., JR., Sales Engr., Crane Co., Kansas City, Mo.
FERRARINI, JOSEPH, Arlington, Va. (*Reinstatement*)
FLAGG, WILLIAM J., Chief Engr., Ohlssons Cape Breweries Ltd., Capetown, South Africa.

GAVELEK, WILLIAM A., Engr. & Partner, Elmer Gylleck & Associates, Elgin, Ill.
GELLERT, LOUIS W., Sanitary & Htg. Engr., Shaw, Naess & Murphy, Chicago, Ill.
GOOTE, MARINUS, Sales Engr., Boot & Co., Grand Rapids, Mich.
GRUENDEL, WILLIAM C., Htg. Sales Engr., McKee Plumbing Supply Co., Cleveland, Ohio.
GUPTA, N. L., Grad. Student, Purdue University, West Lafayette, Ind.

HANCOCK, FLOYD A., Engr., The Auer Register Co., Cleveland, Ohio.
HILTON, JOHN, II, Partner, H. W. Lancaster & Sons, Memphis, Tenn.

KENNEDY, WILLIAM F., Sales Engr., Bethlehem Steel Co., New York, N. Y.
KING, WILLIAM O., Mech. Engr., National Bureau of Standards, Washington, D. C.

LEIGHTON, ALEXANDER H., Branch Mgr., Ilg Electric Ventilating Co., Minneapolis, Minn.
LINIGER, RUDY H., Mfrs. Repr., Larry Harrington Co., Inc., Seattle, Wash.
LOEFFLER, FRANK X., JR., Sales Engr. & Secy., Loeffler-Greene Supply Co., Oklahoma City, Okla.

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MANNON, NEAL R., Air Cond. & Refrig. Engr., A. M. Lockett & Co., Ltd., Houston, Texas.
MARSHALL, JAMES E., Sales Engr., Minneapolis-Honeywell Regulator Co., San Francisco, Calif.
MCKIM, PHILIP H., Mech. Engr., Mehring & Hanson Co., Washington, D. C.
MUSSER, SHELTON A., Chief of Maintenance, The Zia Co., Santa Fe, N. M.

NOLAN, THOMAS J., Salesman, Wesix Electric Heating Co., Portland, Ore.

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PLASS, RAYMOND B., Chief Engr., Ray Oil Burner Co., San Francisco, Calif.

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ROGERS, WALTER M., Sales Engr., Thermal Products C Cleveland, Ohio.

SCROGGS, FRANK M., Sales Mgr., City Fuel Oil & Coal C St. Petersburg, Fla.
SELBY, S. ALLEN, JR., Project Engr., Chase Brass & Copp Co., Waterbury, Conn.
SHORBA, MICHAEL, Engr., Bryant Gas Heating Co., Minn apolis, Minn.
SMITH, EMMETT A., Mfrs. Agent, Southern Heater C Inc., New Orleans, La.
SMITH, ROBERT W., Pres., Robert W. Smith & Co., Lt Montreal, Que., Canada.
SMITH, ULYSSES G., Owner, U. G. Smith Electric & Man facturing Co., Portland, Ore.

TRUCHON, LOUIS P., Sales Engr., Trane Company of Ca ada, Ltd., Toronto, Ont., Canada.

UEBERRHEIN, W. H., Partner, Pacific Electric Sales C Portland, Ore.

VIA, JAMES H., Sales Engr., Creamery Package Manufa turing Co., Salt Lake City, Utah.
VOGEL, GEORGE W., Partner, Pfau-Vogel Co., Indianapoli Ind.
VOLLMAR, THEODORE M., Constr. Supt. & Engr., Boulevar Frontage Co., St. Louis, Mo.

WEAVER, CARSON D., JR., Mfrs. Agent, G. B. Houliston, Cincinnati, Ohio.
WEIANT, ANDREW S., Mgr., McPherson Furnace & Supply Co., Portland, Ore.

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DZIOBA, DONALD D., Draftsman, Trane Company of Canada, Ltd., Toronto, Ont., Canada.

ENGONOPULOS, BASIL G., University of Idaho, Moscow, Idaho.

GLANZ, EDWARD F., Estimator & Asst. Engr., Glanz & Killian Co., Detroit, Mich.

KAUFMAN, MILTON, New York, N. Y.

WARD, WALTER E., Sales Engr., Johnson Service Co., Denver, Colo.
WARREN, DAVID, Sales Engr., Nash Engineering Co., New York, N. Y.
WRAY, HUBERT L., Office Engr., Dan J. McQuaid Engineering Service, Denver, Colo.

Student Members

BARON, ARNOLD E., Student, Texas A & M College, College Station, Texas.

CILACIYAN, ARA, Student, University of Minnesota, Minneapolis, Minn.
CRANE, ROBERT M., Student, Texas A & M College, College Station, Texas.
CROUSE, MARION E., Student, The David Ranken Jr. School of Mechanical Trades, St. Louis, Mo.

KEENEY, WATSON S., Student, Texas A & M College, College Station, Texas.
KING, TRAVIS D., Student, Texas A & M College, College Station, Texas.

PARKER, TRAVIS S., Student, Texas A & M College, College Station, Texas.

RAY, SYLVAN E., SR., Student, Texas A & M College, College Station, Texas.

STEIN, SAMUEL C., Student, University of Illinois, Urbana, Ill.

WARNER, IRA J., Student, Texas A & M College, College Station, Texas.

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ASHVE Research Laboratory

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Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, H. R. Allonier, 101 N. High St., Columbus 15. Secretary, W. M. Myler, Jr., P. O. Box 267, Columbus 16.

Cincinnati: Organized, 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. President, A. W. Edwards, Room 307, 626 Broadway, Cincinnati 2. Secretary, M. E. Mathewson, 1211 Enquirer Bldg., Cincinnati 2.

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Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, W. P. Oster, 410 Camp St., New Orleans 12. Secretary, F. G. Burns, 317 Baronne St., New Orleans 9.

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Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, T. R. Davis, 805 K. P. Bldg., Indianapolis 4. Secretary, P. R. Jordan, 311 E. South St., Indianapolis.

Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, E. O. Olson, 3009 Sixth Ave., Des Moines. Secretary, D. C. Murphy, 214 Old Colony Bldg., Des Moines 9.

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Kansas City: Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, S. L. Furber, 7429 Forest Ave., Kansas City 5. Secretary, H. E. Gould, 1800 Baltimore, Kansas City 8.

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Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, Robert E. Moore, 107-216 Graham Ave., Winnipeg. Secretary, J. R. Stephenson, 278 Main St., Winnipeg.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, C. W. Larson, 128 Brookside Ave., Jamaica Plain, Boston 30. Secretary, A. Ehrenzeller, 23 Parklawn Rd., Boston 32.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, R. H. Hoshall, 65 McCall Pl., Memphis. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, F. R. Bishop, 8011 Dexter Blvd., Detroit 6. Secretary, L. A. Burch, 5853 Hamilton Ave., Detroit 2.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, J. E. Haines, 2747 Fourth Ave. S., Minneapolis 8. Secretary, O. L. Lilja, 5000 16th Ave. S., Minneapolis 7.

Montreal: Organized, 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, T. H. Worthington, 405 Beaubien St., W., Montreal, Que. Secretary, S. W. Salter, 910 New Birks Bldg., Montreal.

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Nebraska: Organized, 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, H. Y. Kleinkauf, 514 S. 11th St., Omaha 8. Secretary, J. G. Bierl, 4927 N. 34th Ave., Omaha.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, W. A. Sherbrooke, 114 Liberty St., New York 6. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, C. Z. Adams, 312 Piedmont Bldg., P. O. Box 1356, Greensboro. Secretary, M. F. DuChateau, 205 S. Lyndon St., Greensboro.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, C. R. Gardner, 1000 St. Louis St., Dallas 1. Secretary, G. A. Linskie, 3124 Milton St., Dallas 5.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, J. E. Wilhelm, 1906 Euclid Ave., Cleveland 15. Secretary, D. E. Mannen, Jr., 9104 Woodland Ave., Cleveland 3.

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Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, G. T. Donceel, Oklahoma Natural Gas Co., Oklahoma City. Secretary, W. W. Frankfurt, 519 Apco Tower, Oklahoma City.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President, V. J. Jenkinson, 1221 Bay St., Toronto 5. Secretary, H. R. Roth, 57 Bloor St. W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, W. B. Morrison, Cascade Bldg., Portland 4. Secretary, E. R. Lokey, 1238 N. W. Glisan St., Portland 9.

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Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, R. E. Le Riche, 6145 39th S. W., Seattle 6. Secretary, C. W. Finn, 320 8th Ave. N., Seattle 9.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, M. G. Kershaw, DuPont Bldg., Wilmington, Del. Secretary, J. W. McElgin, State Rd. and Rhawn St., Philadelphia 36.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, A. F. Nass, 527 First Ave., Pittsburgh 19. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

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Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, F. L. Adams, P. O. Box 840, Denver 1. Secretary, J. J. Johnson, 1010 17th St., Denver 2.

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St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, R. C. Simons, 4030 Chouteau, St. Louis 10. Secretary, W. A. Russell, 7918 Kingsbury Blvd., Clayton 5, Mo.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, B. P. Fisher, P. O. Box 92, Houston 1. Secretary, C. C. Quin, 809 Stuart Ave., Houston 6.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, Art Theobald, 116½ S. Kings Rd. Secretary, R. S. Farr, 2615 Southwest Dr., Los Angeles 43.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, F. C. Benham, Jr., 702 S. Flores St., San Antonio. Secretary, L. S. Pawkett, 810 Insurance Bldg., San Antonio 5, Tex.

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Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, J. T. Young, Jr., Box 709, Ogden. Secretary, E. J. Watts, 2485 Douglas St., Salt Lake City 5.

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Virginia: Organized, 1946. Headquarters, Norfolk, Va. President, R. C. Thomas, 819 Westover Ave., Norfolk 7. Secretary, J. F. Reynolds, Gatling and Marble Ave., Norfolk 2.

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Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, L. B. Nye, Jr., 1100 H St., N. W., Washington. Secretary, J. N. Stewart, 6124 32nd Pl., N. W., Washington 15.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, J. W. Miller, Route 5, Box 498, Lansing. Secretary, K. E. Robinson, 211 Smith Ave., Lansing 10.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, Herman Seelbach, Jr., 45 Allen St., Buffalo 2. Secretary, F. J. Weber, 443 Delaware Ave., Buffalo 4.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, E. W. Gifford, 611 N. Broadway, Milwaukee 2. Secretary, B. M. Kluge, 1817 S. 66th St., Milwaukee 14.

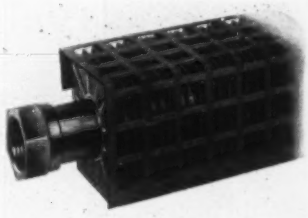
Student Branch

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, K. W. Ryan, Texas A. & M. College, Box 701. Secretary, G. H. Jackson, Texas A. & M. College, Box 2787.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1947 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Extended Surface Radiation Has Aluminum Fins on Copper Tube



No. 3390—Warren Webster & Co., Camden, N. J., has announced Type WI extended surface type radiation consisting of 1⅛ in. copper tubing with rib-reinforced square pressed aluminum fins and brass female couplings.

The tubing is of 0.035 in. thick annealed copper and the fins are of 0.02 in. aluminum formed in 3 in. squares with rounded corners and ribbed for strength. A solid permanent thermal bond is said to be obtained between the copper tubing and the fins by an exclusive process wherein, after assembly of the fins and the couplings on the tubing, the tube is filled with a special liquid and immersed in a freezing tank. The frozen fluid causes the tubing to expand to a desired degree, expanding the collars on the fins to a point where the spacing lugs disappear.

An all welded pressed steel hanger is available for use with the new radiation and the company is also offering a perforated pressed steel cover, shown here.

Units are available in five lengths from 2 to 6 ft inclusive and are fitted with brazed, brass female couplings, 1 in. ips.

Among the many applications for which the company considers this new radiation especially suitable are steam and hot water installations (up to 100 psi pressure) where wall or floor space or both are limited, such as in shops, wash rooms, and in overhead locations such as skylights.

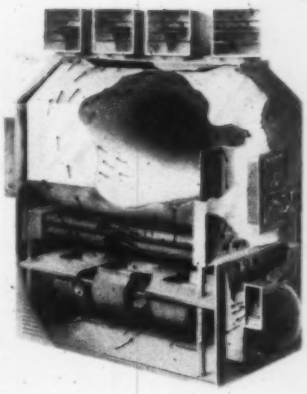
Ship Dehumidifying Unit Designed for Industry

No. 3391*—The "Drynamic" dehumidification unit has been designed by Cargocaire Engineering Corp., 15 Park Row, New York 7, N. Y., for general industrial and commercial use.

Originally developed for keeping ship cargoes dry and in connection with the Navy's ship preservation program, the new units are offered for use in industrial laboratories, packaging and processing plants, warehouses, etc.—wherever excessive humidity constitutes a problem.

External controls are used to provide automatic operation of the units which are available in 10 sizes for handling air quantities from 20 to 13,750 cfm and for removing water vapor in quantities from approximately 0.5 to 11 lb per hr.

Stainless Steel Used in Air Heater

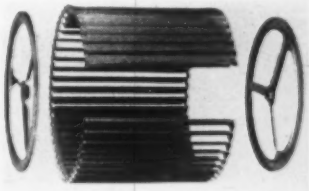


No. 3392—Development of a stainless steel combustion chamber for its commercial and industrial direct-fired heater has been announced by Dravo Corp., Machinery Div., 300 Penn Ave., Pittsburgh 22, Pa. Stainless steel combustion chambers are used for both the company's oil and gas-fired units.

According to the manufacturer, the use of stabilized stainless steel greatly increases the life expectancy of the heaters and eliminates the necessity for using refractory lining.

In the heating unit shown here warm air is discharged horizontally over the floor above workers' heads at a flow rate of about 2000 fpm. Eight different sizes of units ranging from 400,000 to 2,000,000 Btu per hr are available.

Improved Blower Wheel Offered



No. 3393—An improved, resistance-welded blower wheel of five piece construction has been developed by Utility Appliance Corp., Los Angeles, Calif.

Rather than using one standard blade width for various size wheels, the width is said to be proportioned to each wheel diameter. This, says the manufacturer, together with aerodynamically determined blade angles, insures optimum performance for each wheel diameter. The blades are stamped from a continuous steel strip, and dual drive, with hubs at each end, is used to distribute wheel weight close to the bearings and to permit higher torque loads.

Heating, Piping & Air Conditioning [3-47]

6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

3390 3391 3392 3393 3394 3395 3396 3397 3398 3399
3400 3401 3402 3403 3404 3405 3406 3407 3408 3409
3410 3411 3412 3413 3414 3415 3416 3417 3418
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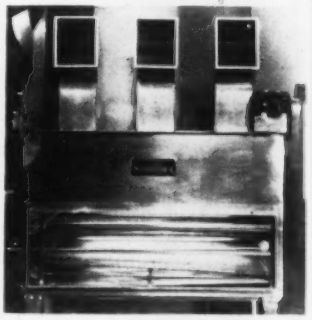
AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.
MAKERS OF UP-TO-DATE STEAM LINE EQUIPMENT FOR OVER 45 YEARS

Offers Rubber Panels for Radiant Heating Systems

No. 3394—"Pliotherm," a wartime development, an electrically conducting rubber, or synthetic rubber which the manufacturer, Goodyear Tire & Rubber Co., Inc., Chemical Products Div., Akron 16, Ohio, recommends for radiant panel heating energized by electric power.

The material is said to be ideally suited to heating large areas to moderate temperatures, to lend itself to integral construction with wallboard, rubber and plastic wall and floor covering, etc. The manufacturer recommends its use for many types of supplementary heating, for radiant panel installations where low initial cost is important and where electric rates are favorable, and for many commercial and industrial applications.

Fan Heater Uses High Pressure Steam

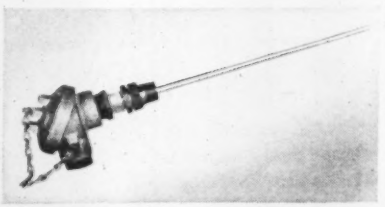


No. 3395—A fan heater for high pressure steam has been announced by the Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y. Used in large scale industrial installations, the unit features a dual coil system.

High pressure steam is condensed in a standard finned coil, the condensate flowing into a trap. The high pressure condensate is then admitted into a header where it flashes into vapor and enters the vapor or condensing coil. The top leg of this coil is finned and steeply pitched, the lower or condensate return leg being relatively flat. Also, in the condensate return header of this coil is a weir designed to keep the liquid level high in that leg. The condensate is withdrawn by a vacuum pump and is returned to the boiler.

This construction, says the manufacturer, utilizes the latent heat of condensation of the high pressure steam, the latent heat of the low pressure vapor, and the sensible heat given off by cooling the final condensate in the air stream.

Resistance Thermometer Bulb Has High Range

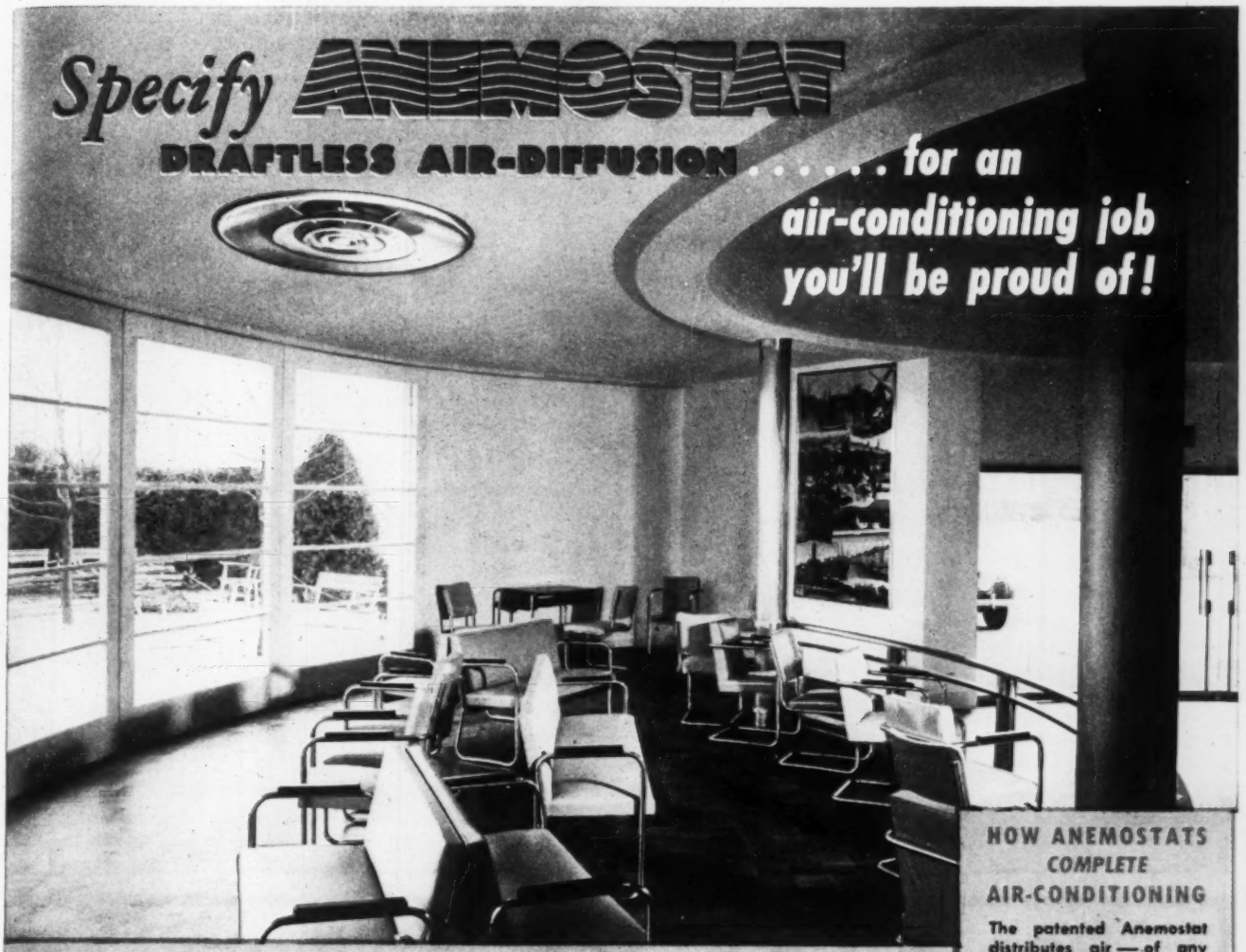


No. 3396—A new type of industrial "Thermohm" resistance thermometer bulb, which extends the range of the company's thermometer recorders and controllers up to 1000 F, has been announced by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

The bulb is said to be amply accurate for the more exacting industrial requirements and to provide rapid response. The tube is of stainless steel and the unit is equipped with the company's standard universal head, which is designed to facilitate installation and connection. Standard lengths are 6 and 12 in.

Specify ANEMOSTAT

DRAFTLESS AIR-DIFFUSION . . . . . for an air-conditioning job you'll be proud of!



The best "advertising" for functional-minded architects, engineers and contractors is the excellence of their own craftsmanship . . . represented by modern structures that make living and working more pleasant. That is why they invariably regard an air-conditioning installation with Anemostat draftless air-diffusion as a job well done. A job that *advertises* them. A job to be proud of!

Anemostat takes the "raw materials" of air-conditioning and actually "processes" them into COMFORT. There are no draft-producing grilles or registers, for Anemostat air-diffusers distribute the conditioned air in pre-determined, controlled patterns. Result: there are no drafts . . . no dead air pockets . . . *room temperature and humidity are equalized throughout.*

Because Anemostat wall or ceiling diffusers permit employment of stepped-up duct velocities and greater temperature differentials, duct sizes and duct outlets may be reduced — an important economy feature. Because Anemostats have no moving parts to wear out, maintenance cost is nil.

Thousands of Anemostat installations throughout the country — in virtually every industry — are putting new comfort into air-conditioning. So, remember to specify Anemostat draftless air-diffusion for an air-conditioning job you'll be proud of!

HOW ANEMOSTATS *COMPLETE* AIR-CONDITIONING

The patented Anemostat distributes air — of any duct velocity — in all directions and in a multiplicity of planes. Simultaneously, counter-currents created by the device siphon *into the Anemostat* room-air equal to about 35 per cent of the volume of the supply air. This room-air is mixed with the supply-air *within the diffuser* before the air-mixture is discharged into the room. Furthermore, velocity of the incoming air is instantly reduced within the Anemostat by air-expansion.

In this way, the Anemostat noiselessly diffuses air of any duct velocity throughout the entire room . . . eliminates drafts . . . closely equalizes temperature and humidity . . . prevents air-stratification. There is no substitute for Anemostat air-diffusion!

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AC-1117

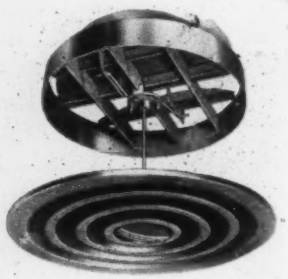
Radiator Cleaner Emulsifies Sludge

No. 3397—"Radklee" cleaning compound is designed to emulsify sludge deposits and all contained insulating wastes that retard heat transfer in steam radiators, steam unit heaters, and automatic valves. It is offered by Apex Engineering Co., 205 W. Wacker Dr., Chicago 6, Ill.

The compound, similar to the company's "Rid-Al" No. 1, which is used on virtually all types of steam equipment, is said to break up sludge containing iron oxide, core sand, oil, light lime, grease, etc., into small particles which are washed down through the return lines as the steam condenses.

Develops Multi-Louver Damper for Diffusers

No. 3398—The new "Aerofuse" multi-louver damper, offered by Tuttle & Bailey, Inc., New Britain, Conn., is designed to control the flow of air to diffusers with a minimum amount of noise and to provide a tamperproof adjustment.



The multi-louver construction is said to provide uniform distribution and accurate adjustment of air volume. The damper can be completely closed, opened, or left in any position by turning the handle in the center of the unit. Louvers can be locked in position and, if desired, the operating handle and rod may be removed.

Combines Damper Positioner, Quadrant, and Indicator

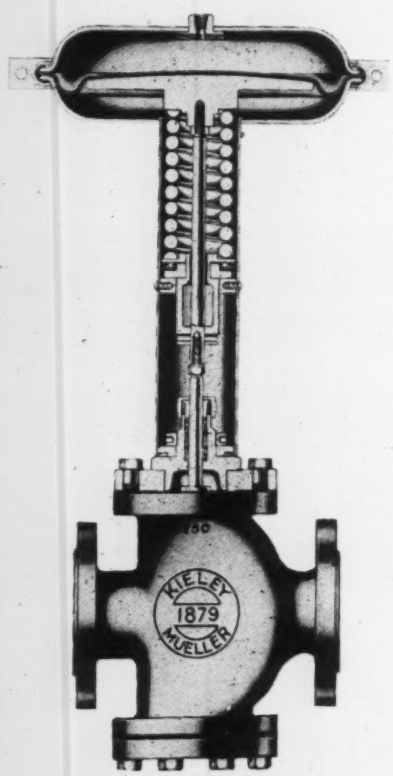
No. 3399—The "Fuelguard" is a damper positioner and quadrant, complete with lubricated bearings, indicator scale, and a locking device, and is offered by the Fuelguard Co., 2826 Fondren Dr., Dallas 5, Tex.**

The unit can be manually or automatically adjusted to the desired damper position, and it is designed for use on medium and large heating and power boilers. It is said to be ideal for use with automatic combustion control systems (since little power is required to operate the largest dampers) and to make possible precision adjustments.

Accessory Line Includes Dehydrators, Strainers

No. 3400—The line of valves, fittings, and accessories manufactured by the Electrimatic Div., Simoniz Co., 2100 Indiana Ave., Chicago, Ill., has been expanded to include strainers and dehydrators using silica gel.

Dehydrators are available in both the nonrefillable and refillable type. The former type, which is said to withstand test pressures up to 5000 psi, has a monel metal inlet screen, 60 x 60 mesh, an outlet filter of porous bronze, and steel flare nuts which are silver soldered to the end caps.



OPEN
for inspection...

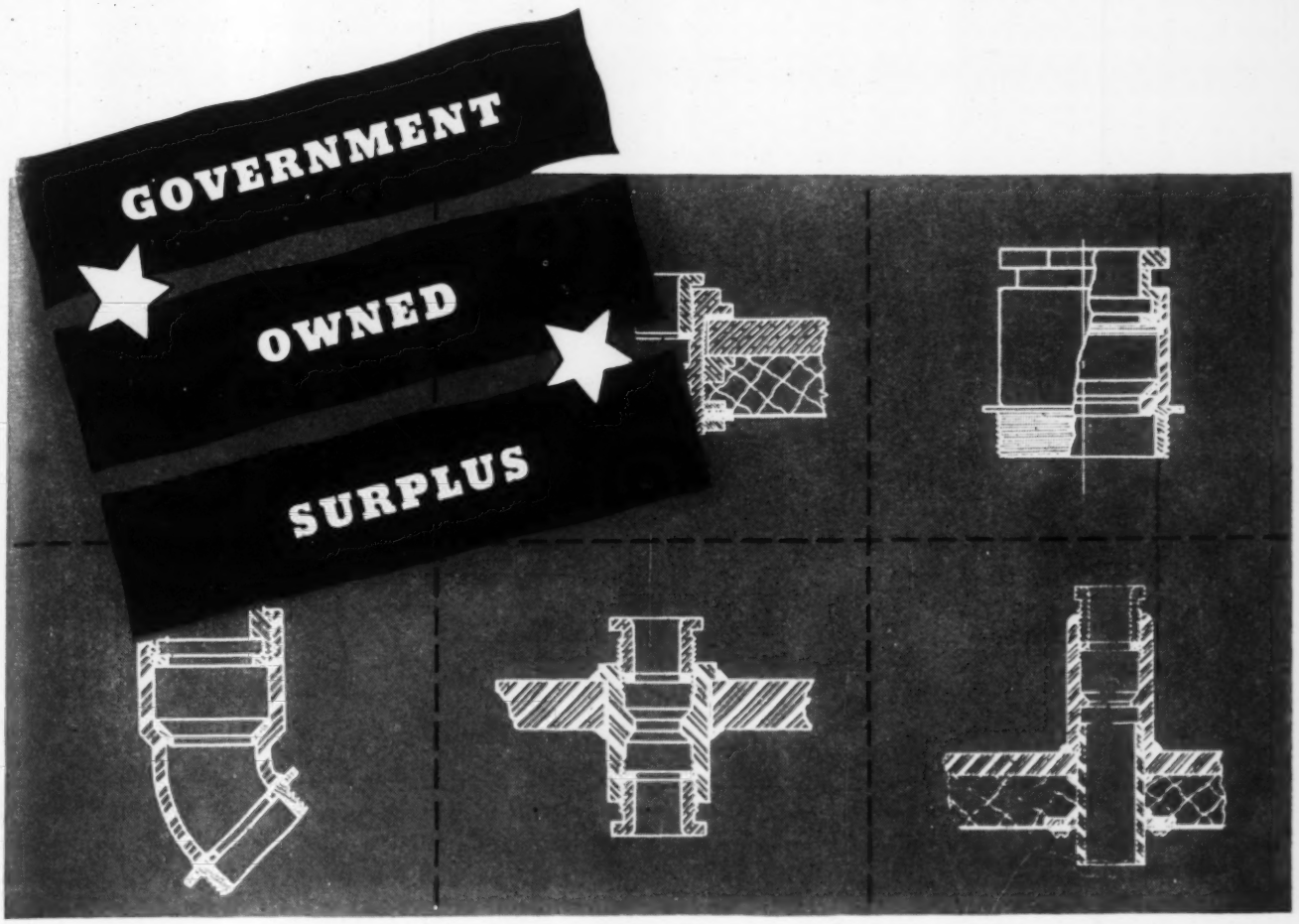
It's easy . . . any time . . . for inspection or maintenance. Just two clamp screws to open and the diaphragm casing is off. Just open the door in the yoke and the spring adjustment and stuffing box are exposed. For other equally important new features of the revolutionary new K & M KONTROL MOTOR, check this list:

- **Pressed steel Diaphragm Casing . . . lighter . . . tougher.**
- **Rigid Welded Steel *Tubular* Yoke.**
- **Duo-seal molded diaphragm provides high travel, uniform loading.**
- **Long calibrated Steel spring . . . fully enclosed.**
- **Enclosed ball bearing spring adjusting screw.**
- **Streamlined Flow Valve Body for high capacity . . . unrestricted flow areas.**
- **Super finished Inner Valve Guides, *honed* guide bushings, top and bottom . . . for minimum friction; increased life.**

KONTROL KIELEY & MUELLER MOTOR

KIELEY & MUELLER, Inc.
2033 43RD ST., NORTH BERGEN, N. J.

REPRESENTED IN
New York City, Detroit, Cincinnati, Houston, Los Angeles, Rochester, Pittsburgh, Tulsa, New Orleans, San Francisco, Chicago, Baltimore, Dallas, Denver, Portland



NAVY TYPE TERMINAL AND STUFFING TUBES

SEALED BID SALE

If you use or sell fittings to take electric cable through walls, ceilings, floors, decks, bulk-heads, housings, tanks, etc., here are items you can use. The component parts are made of Brass, Steel, Bronze or Aluminum and may be adapted to the production of a variety of industrial equipment. Best quality (used for battleships and submarines during the war) and at a price *you* set yourself. $1,200,000 worth of these fittings will be placed on sealed bid sale in March. Make sure you have an opportunity to bid. Write today to each of the WAA offices listed below and ask to have bid offering lists mailed to you. Each of the listed offices will be conducting its own sales. You have 12 chances of being low bidder.

List of WAA offices conducting sales of Navy Type Terminal and Stuffing Tubes during March:

Atlanta · Birmingham · Boston · Los Angeles · Minneapolis · New York Portland · Richmond · Philadelphia · San Francisco · Spokane · St. Louis

NO PRIORITIES NEEDED

OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

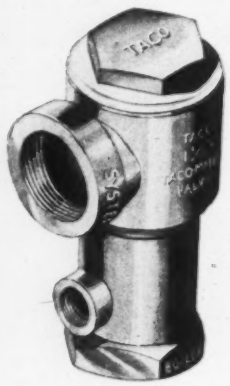
Offices located at: Atlanta · Birmingham · Boston · Charlotte · Chicago · Cincinnati · Cleveland · Dallas Denver · Detroit · Fort Worth · Helena · Houston · Jacksonville · Kansas City, Mo. · Little Rock · Los Angeles · Louisville · Minneapolis · Nashville · New Orleans · New York · Omaha · Philadelphia · Portland, Ore. · Richmond · St. Louis · Salt Lake City · San Antonio · San Francisco · Seattle · Spokane · Tulsa

1030

The strainers are made in a similar manner with porous metal discs being used in lieu of wire mesh.

The refillable dehydrator is of all-brass construction and incorporates a diffusing spiral in connection with the inlet screen. Brass end fittings are silver soldered to brass end caps which are soft soldered to the tube. The inlet screen is designed for easy removal for cleaning or for refilling the unit with silica gel. Dehydrators are offered in sizes from 4 to 32 cu in. and both the dehydrators and strainers are available with end flare fittings from ¼ to ½ in. size.

Thermostatic Valve Controls Forced Hot Water Heating

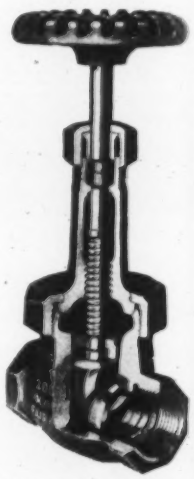


No. 3401—Taco Heaters, Inc., 342 Madison Ave., New York 17, N. Y., has announced the development of the "Taco-Matic" valve for modulating water temperatures to meet changing outdoor weather conditions in forced hot water heating installations. The unit is also designed to improve the performance of tankless or indirect storage type heaters.

The new thermostatic valve, which starts to open at a water temperature of 180 F, is installed in the supply line to the heating system and close to the top of the boiler. When the room thermostat calls for heat, both the firing device and the circulating pump start operating. The valve then permits a mixture of 180 deg water from the boiler and cooler water, which is obtained from the pump discharge by means of a bypass around the boiler, to flow to the supply mains. As long as the boiler water is above 180 F, the mixing will continue until the water temperature in the return builds up enough to satisfy the room thermostat. If the boiler water temperature falls below 180 F, the device will close automatically, preventing circulation through the boiler till its water temperature has again reached 180 F, when more hot water will be fed to the system.

One of the biggest advantages, says the manufacturer, is the fact that a constant supply of hot water is always available for the tankless or indirect storage heater.

Union Bonnet Construction Used in Bronze Gate Valves



No. 3402—The Fairbanks Co., 393 Lafayette St., New York City, has introduced a new line of union bonnet bronze gate valves rated for 200 lb steam pressure.

Of the rising and nonrising stem types, these valves are available with integral seats for regular service or nickel-alloy seats for severe operating conditions. All valves are fitted with nickel-alloy wedges, and the octagonal union bonnet nut is designed to hold the radial body bonnet joint in tight alignment.

AIRTHERM DIRECT-FIRED WARM AIR HEATER

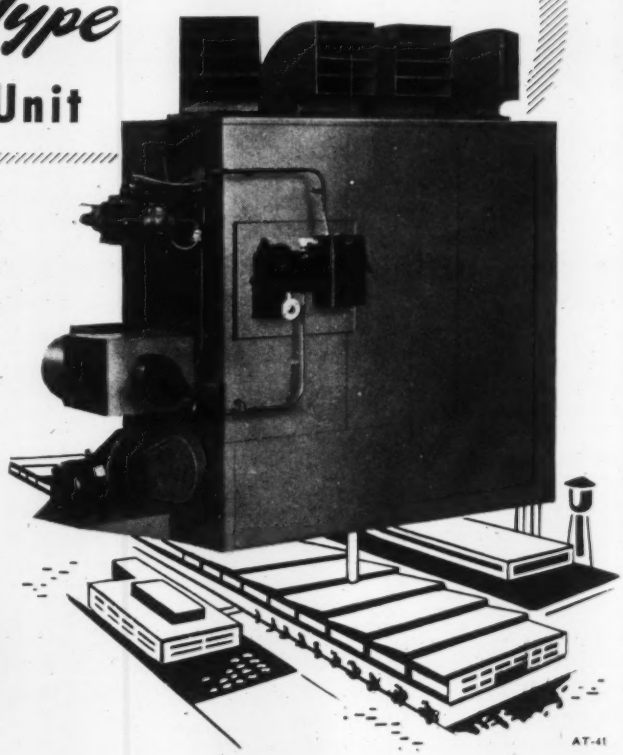
The Most Efficient Type

of Factory Heating Unit

Additional heating capacity for your plant without the necessity of disturbing your present heating system. Flexible enough to permit moving to new location for your future building program.

Capacities from 650,000 to 1,950,000 B.T.U.'s. Either oil or gas-fired.

✓*Write for Bulletin 801 describing this economical heater in detail.*



AIRTHERM MANUFACTURING COMPANY

711 So. Spring Avenue • St. Louis 10, Mo.

HOW TO LICK A PROBLEM IN A FEW STEPS

Let's say some change in your product design, production schedule or fabricating methods gives you a steel problem. It may involve metallurgy, delivery, finish, gauge or width—any of a score of "variables" in specifications.

At Weirton, the solution is only "a few steps" away. For the Weirton Steel Company is an integrated mill, with all phases of operation centralized and coordinated under one roof. Metallurgist, production man, salesman and shipping supervisor can get together on short notice to give your problem prompt attention.

Weirton customers recognize this benefit as the "plus factor" in Weirton steels—Weirite, Weirzin, Weircoloy, Weiralead, hot and cold rolled strip, sheets and ternes, cold rolled spring steel, N-A-X High-Tensile.

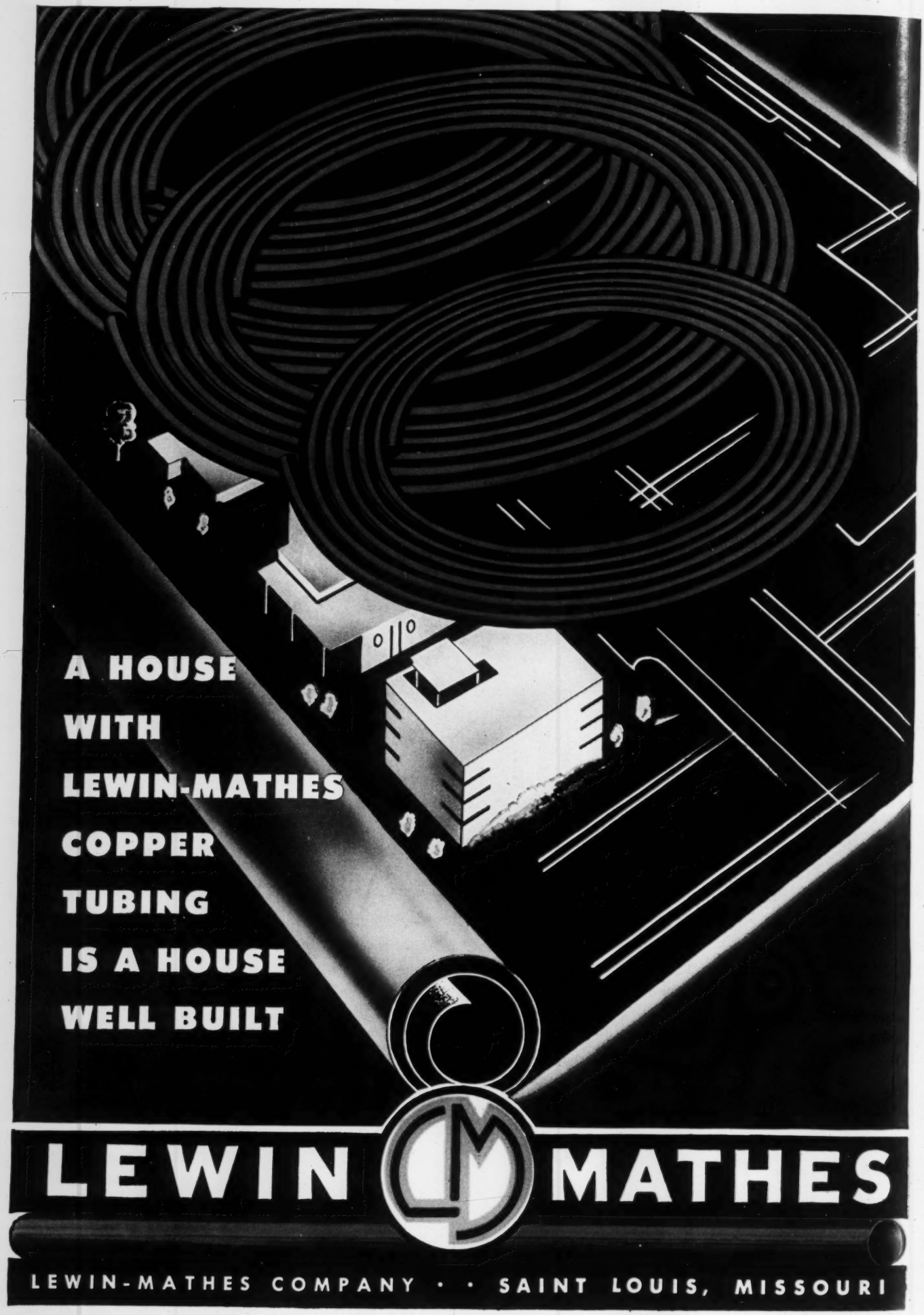
WEIRTON STEEL COMPANY

NATIONAL STEEL

WEIRTON STEEL CO.

WEIRTON, W. VA. *Sales Offices in Principal Cities*

Division of **NATIONAL STEEL CORPORATION** *Executive Offices, Pittsburgh, Pa.*

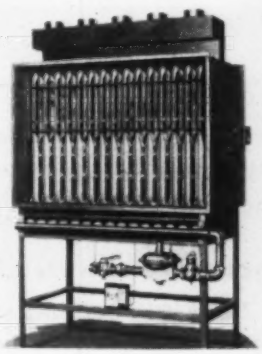

A HOUSE
WITH
LEWIN-MATHES
COPPER
TUBING
IS A HOUSE
WELL BUILT
LEWIN MATHES
LEWIN-MATHES COMPANY • • SAINT LOUIS, MISSOURI

Acoustical Material Applied With Trowel

No. 3403*—The Universal Zonolite Insulation Co., 135 S. LaSalle St., Chicago 3, Ill., has announced the development of a new "Zonolite" acoustical plastic.

The material, which conforms to Federal Specification SS-A-111, Acoustical Materials, Type II, Classes I and FF, is mixed with water and applied with a trowel to any clean, firm, water resistant surface. The manufacturer states that it is ideal for curved, ornate, or irregular surfaces and that it may be painted and waterproofed. In order to maintain acoustical efficiency, spray painting with a nonbridging coat of water-thinned resin emulsion or casein paint is recommended.

Duct Heater Designed for Small Space



No. 3404—The Hayes Furnace & Mfg. Co., 2929 S. Fairfax Ave., Los Angeles 16, Calif., is manufacturing a gas-fired duct furnace, complete with wind tunnel, or casing, and controls. It is designed to be installed into and become a section of a duct system similar to heating coils.

The unit is designed for a comparatively small floor space in ratio to capacity. Hangers may be provided for suspension, and for large Btu requirements the units may be installed in banks. Controls furnished are as required by the AGA laboratory.

The heat exchanger proper is constructed of stabilized stainless steel, of the type used in aircraft engine exhaust manifolds, with all joints welded. The critical temperatures of this steel are said to be 750 F above the critical temperatures of carbon steel, and the noncorrosive properties of the material are said to permit the installation of the unit down stream of cooling coils.

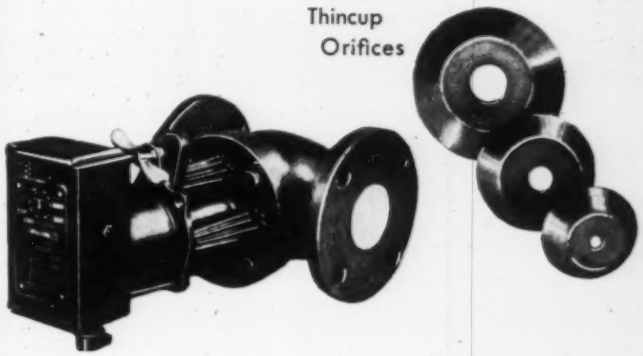
Electro-Pneumatic Operation Featured in Time Delay Relay

No. 3405—The "Agastat" is an instrument developed by American Gas Accumulator Co., Elizabeth, N. J., for introducing a time delay, ranging from a fraction of a second to several minutes, into electrical circuits.

The device consists principally of a timing head, magnet coil assembly, core and spindle assembly, and a terminal block and switch assembly. The time delay is obtained by throttling the flow of air through an orifice in the timing head by means of an adjusting screw. Two basic types of units are offered so that the delay will start either after the coil is energized or after it is de-energized. Both types are said to be instantaneously recycling, readily adjustable, and extremely flexible.

The unit is available for use with a variety of voltages, both a-c and d-c, and for many industrial applications.

TALLMADGE
ON-OFF HEATING CONTROLS
Combine Simplicity and Low Cost



Type C Motorized Valve

Tallmadge On-Off Heating Controls are available in a variety of combinations that meet most heating requirements for thermostat regulation. Their advantages are widely recognized by leading engineers, heating contractors and building owners.

The controls for each zone include a rugged type "C" Motorized Valve regulated by a positive-action thermostat. The type "C" Valve shown, can, at any time, readily be converted to a modulating type valve. Thincup Orifices for insertion in radiator inlets are also provided to maintain even distribution of steam to all parts of the heating system.

Tallmadge Controls are backed by 18 years' experience in meeting all steam heating requirements in institutional, commercial and industrial buildings.

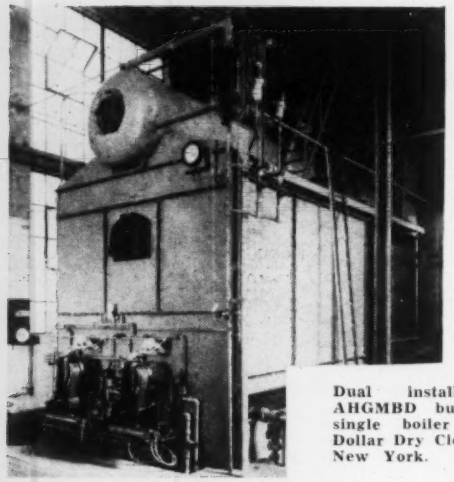
Complete detail information will be supplied on receipt of an inquiry indicating your general requirements whether for On-Off or Modulating types of heating systems.

FOR IMMEDIATE DELIVERY

(1) Motorized Valves
(2) Vacuum Breakers
(3) Thincup Orifices

WEBSTER TALLMADGE & CO., INC.

364 GLENWOOD AVE., EAST ORANGE, N. J.



Dual installation Model AHGMBD burners firing a single boiler in plant of Dollar Dry Cleaners, Buffalo, New York.

precision combustion

DOESN'T JUST HAPPEN

Three exclusive features of York-Shipley Industrial Burners make it possible: the *Flame-Former*, which shapes the flame to fit any combustion chamber; the *Iris Shutter and Tear-Drop Valve*, which by synchronization provides precision air-oil control; the *Automatic Torch Lighter*, a pressure type igniter assuring immediate lighting, safe operation.

customer satisfaction

DOESN'T JUST HAPPEN

It's the natural result of York-Shipley's ability to offer a complete line of direct-drive and belt-drive models from 45 to 400 boiler h.p.—backed by a single policy of "it *must* please the user" in design, manufacture, distribution, maintenance, and servicing of Industrial Burners which reflect priceless quality in every detail.

priceless quality
precision combustion

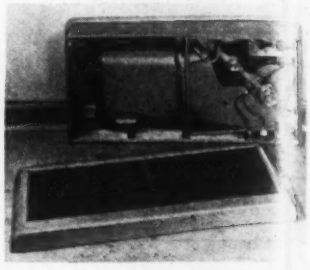
For the story of "Precision Combustion" in York-Shipley Industrial Burners, write for Catalog ID-46-6C. Industrial Division, York-Shipley, Inc., York, Pa.

YORK-SHIPLEY

Oil-Fired Equipment for Industry

AMERICA'S MOST COMPLETE LINE

Develops Gas Furnace the Size of a Suitcase



No. 3406—A new, gas-fired "South Wind" midget furnace about the size of a suitcase has been announced by the South Wind Div., Stewart-Warner Corp., Indianapolis 7, Ind.

The new unit, shown here, is rated at 25,000 Btu per hr maximum output, weighs 70 lb, and is contained in a cabinet 11 x 14 x 32 in. Carrying AGA approval, the unit is designed to burn natural, manufactured, or bottled gas. The key feature is the "sealed flame system, which makes it possible to burn the fuel in a confined, sealed space. This permits the use of small, sealed metal tubes for venting the unit, instead of a chimney." Air for combustion is taken from the weather with the burned products of combustion being vented directly to the outside, and the heating element is of stainless steel.

Modulated heat flow, ease of installation and servicing, and adaptability to zone heating are some of the advantages stressed by the manufacturer.

Protects Ferrous Metals from Corrosion

No. 3407—"Zincilate," an anti-corrosive process which is designed to afford protection to ferrous metals against all common corrosive forces, has been announced by Industrial Metal Protectives, Inc., Dayton, Ohio.**

The process has been used on pipelines, on the interiors and exteriors of water and gasoline tanks and bridges, on machine parts, and on marine installations where it is said to afford not only anti-corrosive but also anti-fouling service.

According to the manufacturer, it is unaffected after 1000 hr exposure in standard salt fog corrosion equipment, as approved by the American Society for Testing Materials. Maximum specifications for the Army and Navy require only 200 hr of salt spray exposure.

The first of ten contemplated manufacturing plants in the United States is being established at Newport News, Va. Establishment of other plants is now being negotiated in all of the important steel producing and consuming countries in the world, and treatment plants for the application of this one-coat process are being established at various strategic points.

Purchases Filter Manufacturing Company

No. 3408—The Badger Corp. of Milwaukee has been purchased by the Air Filter Corp., 2514 Lisbon Ave., Milwaukee 5, Wis.

According to a recent announcement Badger filters are being withdrawn from the market and "Aircor" filters for grease, dust, and for use with welding will be offered. These units are of the permanent cleanable type.

The company expects to move into larger quarters in the near future.

Pressure Switch Has Many Applications

No. 3409—The Aerotec Co. has announced, through its national distributors, the Thermix Corp., Greenwich, Conn., a new line of pressure switches for the control of automatic gas, oil, or coal-fired steam boilers. This switch, Series H-700, is also available for use on air and refrigeration compressors and pumps.

According to the manufacturer, this versatile switch is applicable to many operating maintenance problems or industrial processing jobs where accurate control is essential. Pressure range on the H-701, first in this series, is from 1 to 10 psi with a differential from 1 to 5 psi. Also available are ranges up to 300 psi and differentials from 1 to 80 psi.

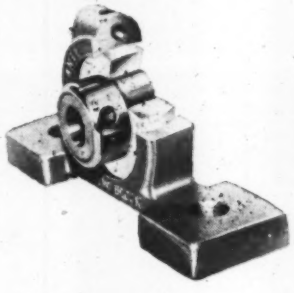
Welding Electrodes Designed for Hard Facing

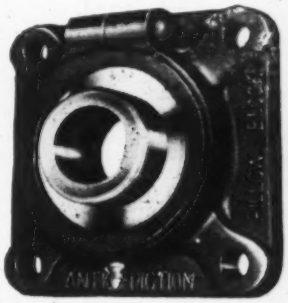
No. 3410—High carbon electrodes for building up worn steel parts by welding with low voltage a-c transformers, as well as d-c, have been announced by The Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio.

The new electrodes are said to open a new field in the application of a-c welders to produce a dense, tough surface of moderate hardness to resist shock and abrasion. They have a heavily extruded shielded arc type coating and are said to produce flat, smooth beads. The deposits can be hot forged, according to the manufacturer.

Aluminum Housing Used on Bronze Bearing

No. 3411—Anti-Friction Bearings Co., 2020 S. Figueroa St., Los Angeles 7, Calif., has announced the "Imperial" self-aligning, bronze pillow blocks and flange units for shaft sizes from $\frac{5}{8}$ to 3 in. in diameter and for speeds up to 5000 rpm.





A split aluminum housing is used to carry the Naval bronze bearing and a ground adapter sleeve is inserted in the bearing so that one basic pillow block may serve a number of shaft diameters.

Plenty of Jobs Where Black & Decker Standard Drills Fill the Bill

YOU always get the *right* drill for the *right* job from the big Black & Decker Drill line. Take Black & Decker *Standard* Drills, for example. They're specifically designed for the *intermittent* drilling you do in heating, piping and air conditioning jobs. Jobs where a heavy-duty model, built for *continuous* work, would be just *too much* drill.

Made in many sizes, Black & Decker *Standard* Drills drive twist drills in piping, steel plates, ducts, vents, frames, braces and other metal parts—drive B & D Hole Saws for cutting clean, round holes in any material a hacksaw will cut—drive wood augers for running piping through flooring and installing heating and air conditioning units. Ask your nearby Black & Decker Distributor for complete details. Write for our complete catalog to: The Black & Decker Mfg. Co., 628 Penna. Ave., Towson 4, Md.

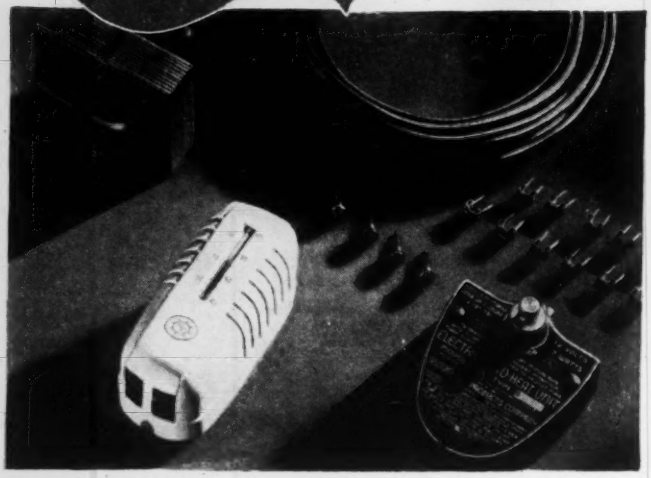
LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS

this A-P HEAT REGULATOR SET For Oil Heaters

Adds Extra Profits on new-and old-sales



RIGHT NOW, when Spring brings widely fluctuating outdoor temperatures, is the time to tell your heater customers about the fuel saving convenience and comfort of *A-P Thermostatic Temperature Control.* You can install an A-P Heat Regulator Set on most oil heaters — new ones as well as those you sold as far back as 1939 — for most of them use A-P Model 240-DR, UR, or YR Manual Controls. You can talk about 10% to 25% fuel savings — avoiding danger and discomfort of overheating — the luxury of healthful home temperatures by the mere setting of a thermostatic dial.

THE COMPLETE "Sales Package" is inexpensive, easy to install either permanently, or movable in case of rented homes. The Set includes an Electric Conversion Top for mounting on present manual control, an accurate Wall Thermostat, a Transformer, and all accessories and necessary instructions.

Add some extra Spring sales and profits NOW! Write for prices, samples and selling material

BE SURE YOUR NEW HEATER LINES USE... **A-P DEPENDABLE** OIL CONTROLS — for faster sales, greater customer satisfaction.

AUTOMATIC PRODUCTS COMPANY

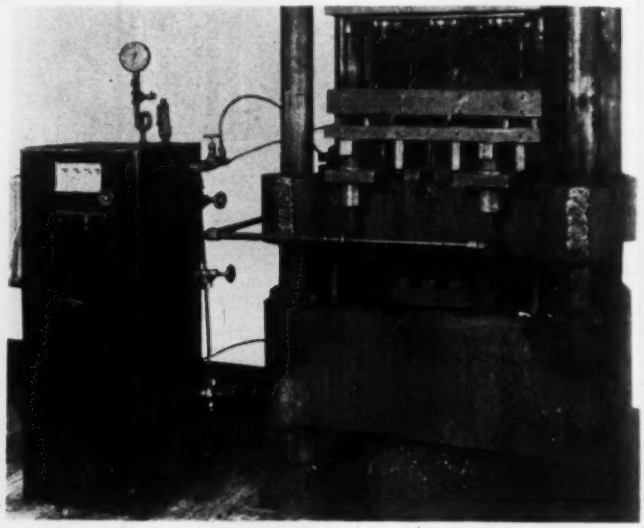
2460 NORTH THIRTY-SECOND STREET, MILWAUKEE 10, WISCONSIN

DEPENDABLE *Oil Controls*

DESIGNED TO ELIMINATE SERVICING

Small Electric Steam Boiler Utilizes Solid Rods for Electrodes

No. 3412—A 2 hp "Speedylectric" steam boiler, for pressures up to 200 psi, has been developed by Livingstone & Co., 89 Broad St., Boston, Mass.

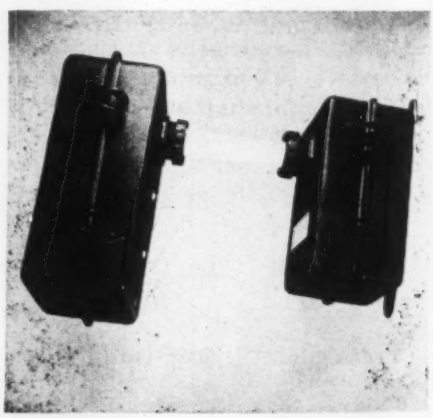


The small diameter vessel in the boiler is said to produce about 65 lb per hr of steam and to use solid rods for electrodes. These are installed in such a manner as to utilize the water between them as the resistance element. This is said to eliminate the danger of low water level, for in the absence of water, electrical contact of the heater elements is not made. The unit is recommended by the manufacturer for many applications where process steam is to be generated, especially where flame hazards exist.

Photoelectric Cell Warns of Excessive Smoke

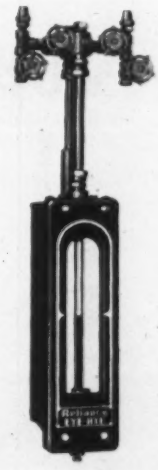
No. 3413—Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass., has developed the Type A20C photoelectric smoke indicator for use with heating or power plants.

Basically, the unit consists of a photoelectric control and a light source which are mounted on opposite sides of the flue. A sensitivity adjustment is included to permit the equipment to be set so that a warning signal will be given when the smoke density approaches that prescribed as maximum by local smoke ordinances.



Supplementary equipment, also available, includes bell alarms, densometers to give continuous indications of smoke density, and recorders. The device is designed for use with 115 volt, 50-60 cycle a-c current.

Redesigns Remote Liquid Level Indicator



No. 3414 — The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio, has announced a newly styled and redesigned model (E-32) of the "Eye-Hye" remote reading liquid level indicator which the company has marketed for the last 10 years. This model is the first of several which will replace the original series.

Besides the use of a new face plate, the construction has been altered by the use of a plastic diffusing screen and by redesigning the case to make the interior more accessible for cleaning and renewing the illuminating lamp. The case is now drip-proof.

Offers Stainless Steel Electrodes for a-c, d-c, Reverse Polarity d-c

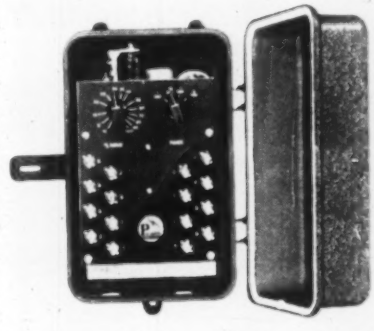
No. 3415—A new line of stainless steel electrodes in a full range of grades and diameters has been introduced by the General Electric Co., Schenectady, N. Y.

The elecrodes are available in two types of coatings, one designed for a-c or d-c use, and the other for reverse polarity d-c operation. They can be used in all welding positions.

Times Process and Machining Operations

No. 3416—Type 30HL1, electronic timer, for intervals from 1 20 sec to 4 min is offered for process control and machine timing where accuracy, long life, and repeat-cycle operation is required. The manufacturer is Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass.

The timer is designed to control such equipment as spot welders, grinders, honing and drilling machines, conveyors, and filling machines. Interval, delayed action, automatic repeat, and programming are the four basic types of timing offered by this unit. In addition, a number of variations of these basic types are available and all combinations may be utilized by changing external connections to the terminal board. Features of the unit are said to include extreme flexibility and accuracy within 2 per cent.



Timers are available for use with 115 or 230 volt, 50-60 cycle, a-c current and the two single pole, double throw relays are rated at 10 amp, 115 volt, a-c (main output) and 1 amp, 115 volt, a-c (auxiliary). Ambient temperature rating is 32 to 150 F and the net weight is 8 lb.

SPEEDY
Pipe Cutting
MADE EASY

Efficiency-balanced
RIDGID
PIPE CUTTER
cuts true, fast, with least effort

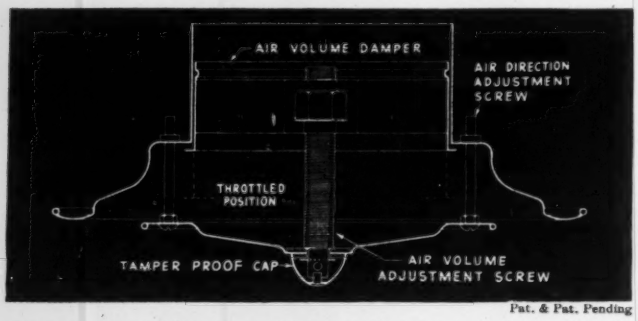
No. 42 4-wheel, fast quarter-turn cutting.

● It's less work to cut pipe with this new style RIDGID that rolls through any pipe fast and easily, leaves practically no burr. Beautifully balanced special malleable frame, its heavy-duty tool-steel wheel always cuts true, every cutter factory tested. Choice of 5 sizes to 6"capacity—4-wheel cutters to 4." Save time and muscle—buy at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

How ADJUSTABLE air diffusers increase the efficiency of supply air distribution

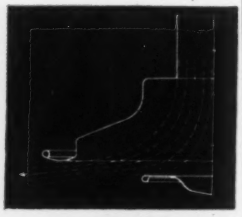
Kno-Draft Adjustable Diffusers offer all the advantages of draftless air diffusion plus fast system balancing and air pattern control

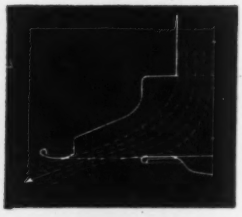


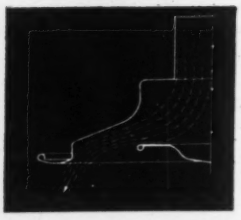
Pat. & Pat. Pending

Fast System Balancing: Volume damper regulates the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Positive Air Pattern Control: Air direction adjustment affords any angle of air discharge from vertical to horizontal needed to accommodate ceiling heights, individual or seasonal requirements. It can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.







Specify Kno-Draft Adjustable Air Diffusers for better mixing control of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air distribution.

Send for FREE handbook containing sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers. For your copy, please write Dept. D-12 on company letterhead.

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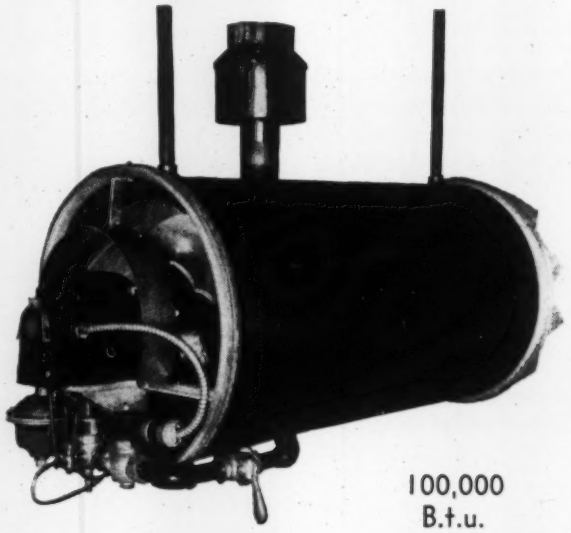

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NEW UNIT HEATER

This new and unique design in suspended space heaters features: **More Head Room—Compact Design—More Heat from gas burned,** gas company test shows overall efficiency of 82%.

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Where floor space is at a premium this turbine unit has greater heating capacity. Controls are built-in. Unit is shipped completely assembled ready for installation.

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One unit will heat a 40' x 80' space. It is A. G. A. approved for liquefied petroleum gases, manufactured or natural gas.

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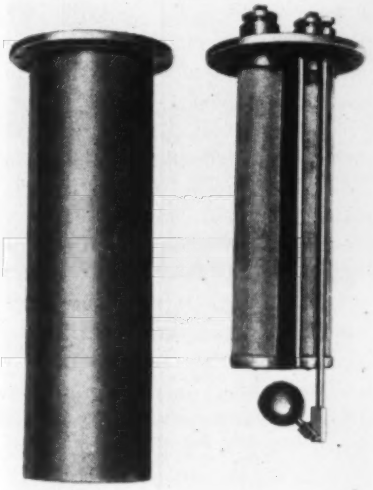
Soot Remover Designed for Industrial and Marine Boilers

No. 3417—A chemical soot remover, "O'Burnit," which is designed for cleaning oil or coal-fired marine and industrial boilers, has been announced by O'Brien Industries, Bala-Cynwyd, Pa.**

The compound is made of six chemicals and is said to lower the ignition point of both caked and loose soot and to supply ample oxygen for combustion.

Oil Separator Has Double Cartridges



No. 3418—An oil separator, in capacities from ¼ to 10 hp, has been developed by Acme Industries, Inc., Cor. of Mechanic and Ganson Sts., Jackson, Mich., and is offered to the refrigeration and air conditioning industry.

Oil separating cartridges on both the gas inlet and gas outlet are said to provide improved performance and the use of baffles is designed to prevent short circuiting. The new design, says the manufacturer, offers many improvements over the older models, including better accessibility for servicing.

Equipment "Shorts"

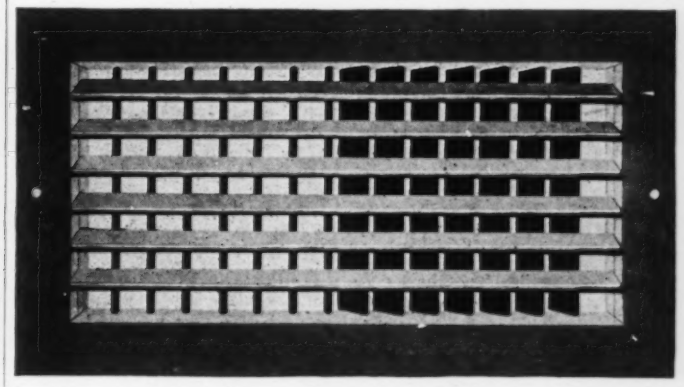
Production of the new "Gemco" packaged type air conditioner totaled about 100 in January with peak production expected by midsummer, according to General Engineering and Mfg. Co., St. Louis.....

The "inside story" of steel gate valves manufactured by the Ohio Injector Co., Wadsworth, Ohio, was told at last December's New York power show when the company exhibited a huge plastic valve, said to be the only one in existence. An ingenious arrangement kept the valve opening and closing.....Tinnerman Products, Inc., Cleveland, has licensed Shakeproof, Inc., Div. of Illinois Tool Works, Chicago, to manufacture and market "Speed Nuts" and "Speed Clips." Classifications covered include U type, J type, and latching type fasteners. Shakeproof will go into production during the current quarter.

The Navy's fleet preservation program, popularly known as "Operation Zipper," was responsible for many developments and refinements in dehumidification equipment. With the success of the program assured and with the Navy's immediate needs taken care of, various manufacturers are offering equipment for commercial and industrial use where atmospheric moisture would cause harmful corrosion, mold, mildew, and general deterioration. Now available are the dehumidification machines manufactured by the Pittsburgh Lectrodryer Corp. of Pittsburgh and the automatic recorder-controller units offered by the Friez Instrument Div., Bendix Aviation Corp. of Baltimore.

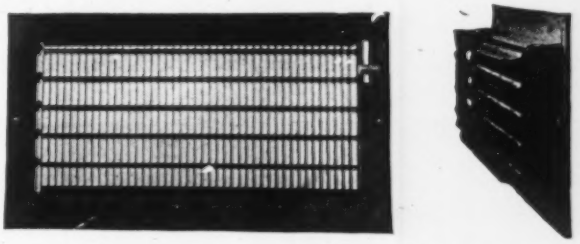
YOU CAN GET IT QUICKER FROM

STEWART



HIGH VELOCITY OUTLETS

Style DDH is one of 8 variations of Stewart High Velocity Outlets that can be supplied with or without volume valves. Each bar is adjustable with a key (furnished). This unit is a heavy attractive Outlet made in all popular sizes, with matching fixed-bar down-deflecting return grille. *HIGH VELOCITY OUTLETS CAN BE SUPPLIED TO FIT CONTOURS OF CABINETS FOR ROOM COOLERS.*



MULTIPLE DAMPER REGISTERS

For Wall or Baseboard

Style 74—Register. This Register utilizes 1" multiple-dampers to control volume and vertical direction. Multiple dampers may be set so as to obtain up, straight, or down deflection, as well as complete shut-off. The face is the same as all others of the "70" line—permitting air deflection right or left by adjusting front blades with key furnished. Blades are ¼" center to center, and ¼" in depth.

THE COMPLETE STEWART LINE

The Stewart line is competitively priced and consists of a wide variety of popular types and sizes (not shown) of High Velocity Outlets, Wall and Baseboard Registers, Diffusing Grilles and Radiator Fronts that meet most air-conditioning and heating needs. Construction is substantial and of cold rolled steel protected with a priming coat. Special types and sizes can be made to your specifications.

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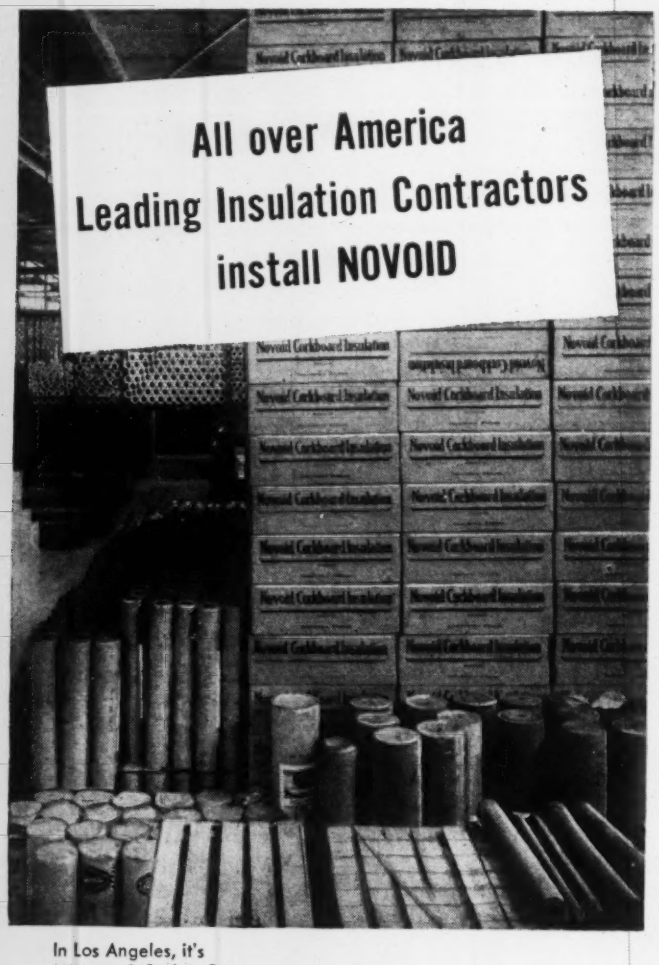

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PROMPT DELIVERY of Novoid Cork Pipe Covering can now be obtained through good insulation contractors throughout the U. S. Many Novoid contractors maintain warehouse stocks for immediate installation.

Novoid Covering is the moulded rigid insulation that efficiently reduces your cost of refrigeration. It snugly hugs pipes and fittings of every size and shape, does not sag, does not absorb moisture or odors, and is long-lasting.

For complete facts about Novoid Pipe Covering, Corkboard, and sundries specially developed to make low-temperature insulations most efficient, write to Cork Import Corporation, 39 Park Place, Englewood, N. J.

NOVOID INSULATION

CORKBOARD · PIPE COVERING

NEW BOOKS & REPORTS

Popular Heating, Air Conditioning Text Revised in 6th Edition

The well established text by Allen and Walker has reached the sixth edition and John W. James, formerly technical secretary of the ASHVE, has become a co-author. The book is still intended as a textbook, although more material has been included to illustrate engineering practice in the fields of heating and air conditioning.

Of particular value to the student is a chapter that discusses the design of an actual air conditioning system from the original survey information to the selection of equipment and controls. It is no small task to condense design procedure into a single chapter because at almost any stage of the work numerous alternate solutions might be considered. Also, because every step must be shown in detail and explained, the methods used are not necessarily those used by practicing engineers.

The subject of psychrometrics is covered in the simplified and generally used manner in the text proper while the more exact method is included in the appendix.

Among the subjects that have been receiving widespread coverage in technical literature since the previous edition (1939) are panel heating, reverse cycle refrigeration systems, odor removal apparatus, and air sterilization methods. All of these are discussed in the new edition, with practical pointers stressed.

The chapters on gravity warm air furnace heating and residence air conditioning have been revised to include the latest data of the industry. Forced circulation, hot water heating has received more attention.

It is evident that major effort was expended to bring the entire text up to date as well as to make it more useful to teacher and student alike.

Heating and Air Conditioning by Allen, Walker, and James is published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. The 6 x 9 in. text contains 667 +vii pages and is clothbound. The price is $5.50. (Reviewed by Realto E. Cherne, consulting engineer, Rochester, N. Y.)

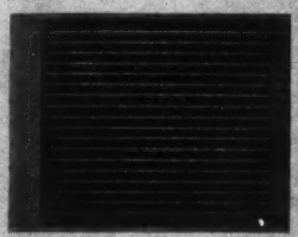
New Specifications Cover Many Steel Piping Materials

In addition to specifications covering steel piping and tubing, the December 1946 compilation of ASTM Specifications for Steel Piping Materials includes requirements on a number of other materials which are used in piping installations, such as castings, forgings, bolting materials, and nuts.

The book includes 14 specifications covering various types of pipe ranging from ordinary carbon pipe for a variety of uses to high alloyed steels for high temperature and high pressure service. Thirteen specifications cover various types of boiler, superheater, and miscellaneous tubes including four standards on stainless tubing. Three specifications cover still tubes and a similar number pertain to heat exchanger and condenser tubes. Five standards cover castings used in pipe installations including valves, flanges, and fittings

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

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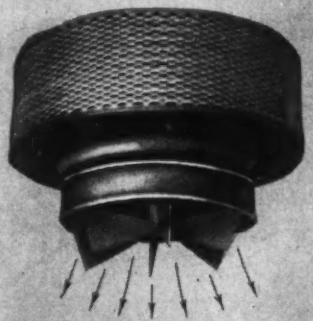

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

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A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

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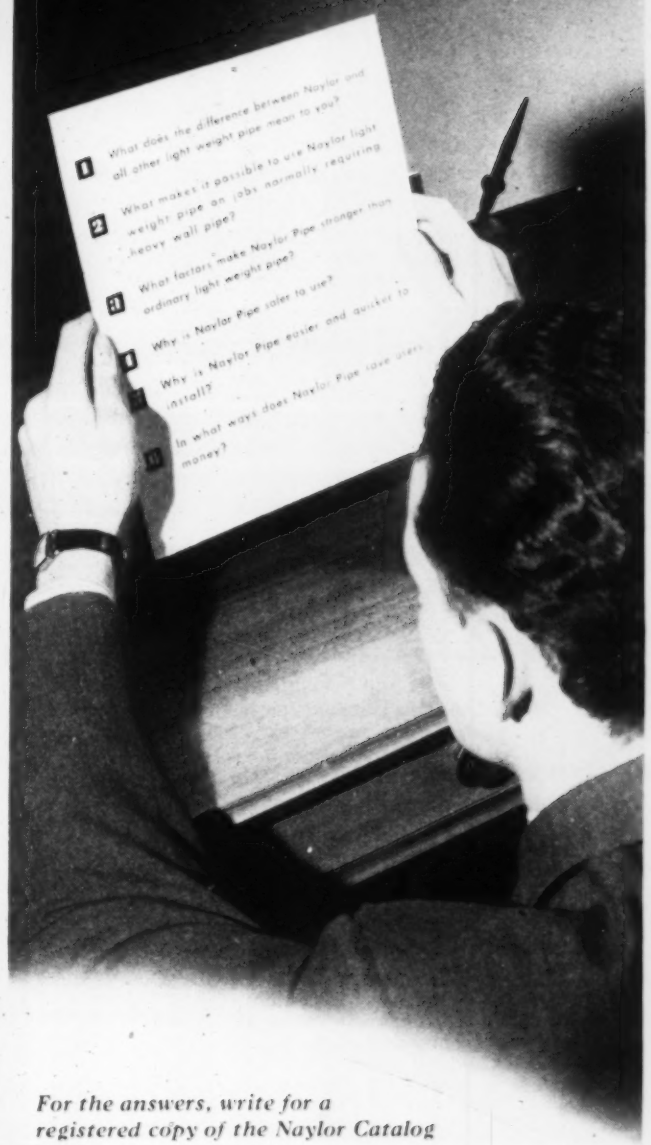
You'll be Money Ahead to Know the Answers


1 What does the difference between Naylor and all other light weight pipe mean to you?
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and there are four specifications covering forgings and welding fittings. Standards covering carbon and alloy steel bolting are also included.

In paper cover, the 307 page publication (6 x 9 in.) can be obtained from the American Society for Testing Materials headquarters, 1916 Race Street, Philadelphia 3, Pa., at $3.00 per copy; reduced rates are in effect on orders in quantity.

Air Conditioning Should Include Sterilization

Air conditioning engineers should consider the possibility of using ultraviolet light irradiation and/or the use of germicidal vapors in the interests of reducing the incidence of disease, according to B. H. Jennings, chairman, department of mechanical engineering, Northwestern University, in a recent paper.

The problem of distributing glycol vapors into large spaces was the subject of a research investigation conducted at Northwestern for possible use in reducing cross infection in living groups or dormitories. Subsequently, the principles which had been developed were applied to several military installations where it was demonstrated statistically that the disemmination of glycol vapor into the air reduced the incidence of infection.

In his paper, Air Conditioning and Sterilized Air, Mr. Jennings briefly describes the research studies and reports on the findings. He points out that while ventilation is the simplest means for reducing the number of organisms in an enclosed space, a limit is soon reached where it is not economical to bring in additional quantities of outside air. He also says that filtering and electrostatic precipitation will remove dust and organisms in the air which is circulated in or supplied to a space, but the danger of infection still exists.

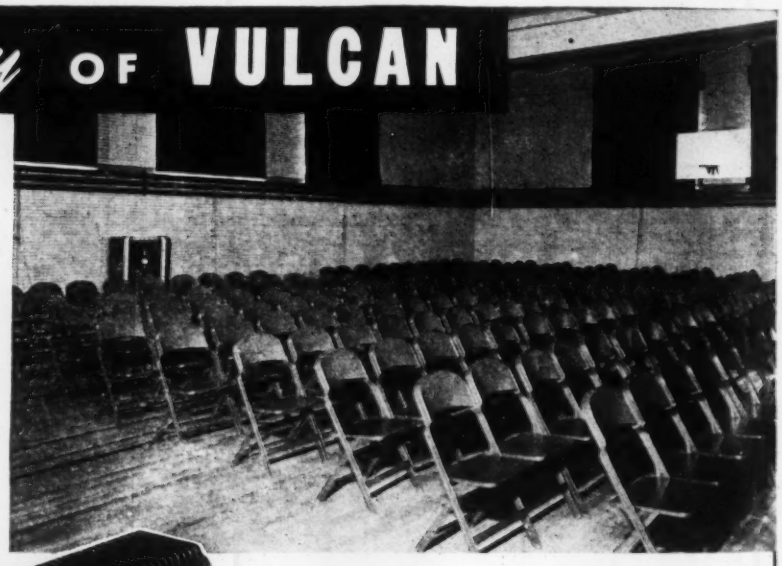
In regard to ultraviolet light irradiation, it is stated that this was one of the first satisfactory methods used as micro-organisms exposed to the direct action of such rays are instantly killed. However, there are certain limitations in using this method for irradiation can be used only in those zones where the rays can be directed without interference with the occupants of the room. The use of these lamps is also restricted by the cost of installation and operation and the killing effect varies on different types of bacteria. This method does, however, assure a large reduction in bacterial count.

Triethylene glycol and propylene glycol were found to be satisfactory for killing germs, the former being the most effective. A method wherein a warm air supply is blown over surfaces wetted by an aqueous glycol solution has been found to be probably the most successful means for introducing the vapors. The author states that the older theory that air must be treated by aerosols in suspension as a fog has been dispelled in the case of glycol treatment.

In conclusion, the paper indicates that both ultraviolet light irradiation and glycol treatment are available and practicable when properly applied and that a new threshold is being crossed in the control of diseases.

This five page paper is contained in the September 1946 (Vol. 51, No. 3, part 1) issue of the Journal of the Western Society of Engineers, 205 W. Wacker Dr., Chicago 6.

THE *Versatility* OF VULCAN



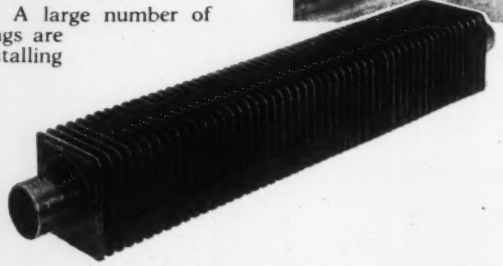
VULCAN, the accepted continuous line radiation, has proven extremely versatile in application. ***Here are some of its advantages:***

Light Weight. It is light and compact but strong and rigid. Sections come cut to length and ends are threaded or chamfered.

Uniform Heat. There is little temperature difference between floor and ceiling and horizontal temperature is uniform.

Greater Output. Maximum heat distribution is obtained with the Vulcan offset fin construction. One length of VULCAN 1¼" is equal to 8 pipes of the same length 1½" diameter.

Few Fittings. A large number of valves and fittings are eliminated by installing VULCAN.



VULCAN Radiation solved a heating problem in this gymnasium. Radiators were installed easily up high out of the way. Down drafts were eliminated and even temperature control was maintained.

VULCAN—HARTFORD is stamped on every radiator.

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RADIATOR MANUFACTURERS FOR MORE THAN TWO DECADES

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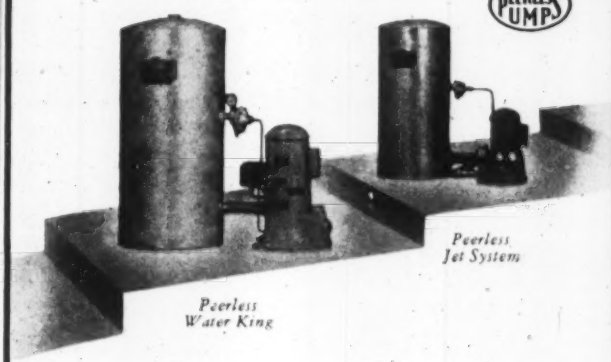
DOMESTIC WATER SYSTEMS . . .

PEERLESS PUMPS



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Peerless Dealers **WILL SELL A GOOD SHARE OF DOMESTIC WATER SYSTEMS** ***Everywhere!***

PEERLESS WATER KING For shallow well pumping. Capacities: 275 to 860 gallons per hour. The only Domestic Water System applying the "magic" water lift principle for simplicity and economy of operation. 100% automatic. Pumping element is integral part of pump base; only needs connection of suction pipe over well.

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For deep or shallow well pumping. Capacities: 400 to 5000 gallons per hour. Lifts: Up to 120 feet. Highly advanced, precision built for utmost economy and efficiency. Installed over-well or offset. 100% automatic.

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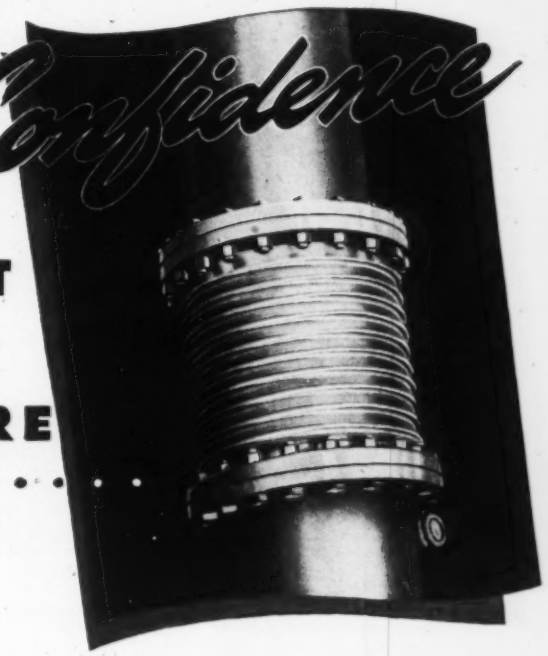

PICTURED above is a typical Zallea 24" Stainless steel low pressure Expansion joint installed on an exhaust gas recovery line of a large mid-western Automobile Plant where heavy schedules demand uninterrupted production. After a performance test of several makes of expansion joints over a number of years, the preference was unanimously Zallea. The reason . . . confidence.

It's that *confidence* in Zallea expansion joints to absorb movement due to contraction and expansion of pipe lines *without failure* that has made this Zallea product the number one expansion joint today.

It's the *quality* Zallea builds into every expansion joint that makes the difference. Remember, there's *no* packing to deteriorate . . . *no* maintenance required. Specify Zallea expansion joints . . . and be sure!

Zallea Corrugated Expansion Joints are made in non-equalizing, self-equalizing and duo-equalizing types, depending upon the conditions under which they must operate . . . of copper, stainless steels and other corrosion-resistant alloys . . . diameters from 3" upward . . . traverses up to 7½" . . . for pressures from vacuum to 300 psi . . . for temperatures from sub-zero to 1600° F. Let us quote on your requirements.

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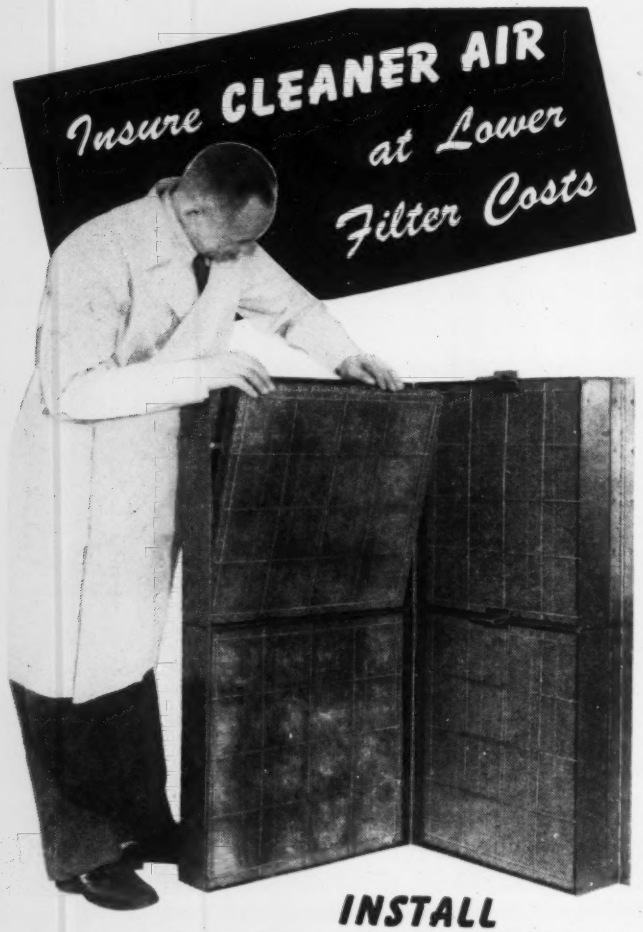
Specify and Demand ZALLEA *Furnace-Annealed* Flexible Connectors



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WRITE FOR FREE TECHNICAL DATA BOOKLET ON FILTERS AND FILTER BANKS.

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MEETINGS & CONVENTIONS

Conference to Stress Production Techniques

Designed to cover every phase of the production cycle, the Chicago production conference, March 17-19 in the Stevens hotel, will have 35 conference sessions devoted to production-line and general management techniques. Samuel R. Lewis, consulting engineer, will speak on heating and ventilation during the panel session on Designing the Modern Factory, to be held 2 to 4 p.m. on March 18.

Supplementing the conference, the concurrent Chicago production show will have exhibits by 130 manufacturers of new materials, tools, handling and packaging equipment, instruments, and miscellaneous services. P. A. Jenkins is executive secretary of the Chicago Technical Societies Council, 53 W. Jackson Blvd., Chicago 4, Ill., sponsor of the show.

Lubricating Engineers Plan Technical Sessions

The American Society of Lubrication Engineers, 55 E. Washington St., Chicago, Ill., has scheduled four technical sessions, a number of luncheon meetings, a smoker, and a banquet for its second annual meeting, to be held March 17-19, Hotel William Penn, Pittsburgh.

OHI Plans Broad Program for Meeting

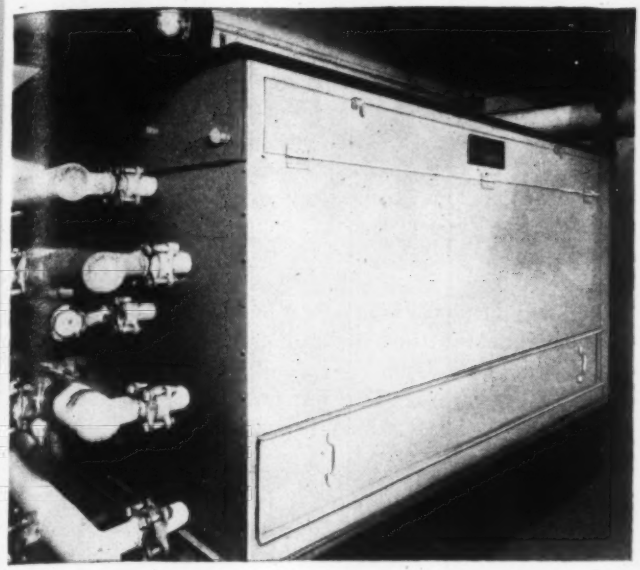
March 24-26 are the dates of the 24th annual convention of the Oil-Heat Institute of America, 30 Rockefeller Plaza, New York 20, N. Y. The meeting, which is to be held at the Hotel Traymore, Atlantic City, N. J., is expected to be unusually broad and comprehensive. According to the program, convention days have been designated as institute day, engineering day and industry day, in the order named. The engineering session is scheduled for 2:30 p.m., Tuesday, March 25. Papers will be presented on heavy oil burning equipment, uses and installation of equipment, and fuel oil requirements in relation to oil availability. Professor W. J. King of Cornell University is scheduled to speak on Combustion and Heat Transfer Knowledge Gained from Jet Engines.

Welding Society to Meet During Western Metal Show

The American Welding Society, 33 W. 39th St., New York City, has scheduled a four day meeting, March 24-27 inclusive, during the Western Metal Exposition and Congress to be held at Oakland, Calif., March 22 to March 27. The program for the AWS meeting includes 15 papers by welding engineers on various types of welding and their practical applications. The meeting headquarters of the society will be in the Hotel Leamington, Oakland.

Sponsors Air Conditioning Conference in Oregon

The Oregon chapter of the American Society of Heating and Ventilating Engineers and the department



Chilling Water With Accurate Control of Temperature

Regardless of either variation in the cooling load or intermittent operation, the new Niagara Liquid Cooler holds the delivered temperature accurately at the required point. It will deliver fresh water at 33°F. constantly without danger of freezing damage and produces lower temperatures accurately in non-freezing chemical liquids and solution.

Capacity range in available models is from 24 to 465 gallons per minute. High capacity and fast chilling are provided in extremely compact space. The cooler is reliable and easy to maintain; all parts are accessible for cleaning; insulation is easily applied; operation is economical of power and refrigeration.

Write for Bulletin No. 100-HP.

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Over 30 Years' Experience in Industrial Air Engineering

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INDUSTRIAL COOLING HEATING • DRYING

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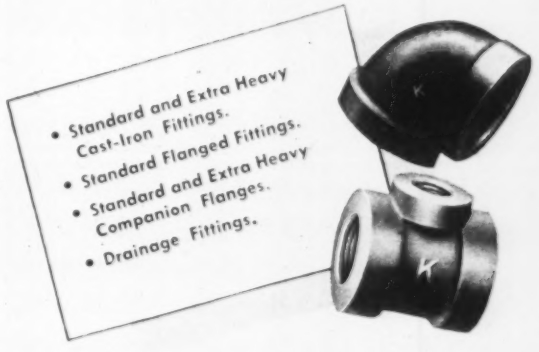
FIDO DIDN'T DO IT!

The puddle came from a leaky fitting. A cold check opened up from expansion and contraction.

It wasn't a "K" fitting. No, Sir! Because "K" fittings are precision-made in the first place, and then carefully examined for possible defects by eagle-eyed inspectors.

Play safe by looking for the "K" on the cast-iron fittings you buy and install.


• Standard and Extra Heavy Cast-Iron Fittings.
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INSPECTED FITTINGS

COMBINED MARKET FACILITIES at Malleable Iron Fittings Co., Branford, Conn., and at Kuhns Bros. Co., Dayton, Ohio.

of mechanical engineering, Oregon State College, are sponsoring the fourth Oregon State air conditioning conference which will be held at Corvallis, Ore., March 27-29. The program will consist of talks followed by discussion periods with practical applications being stressed throughout. Among the many topics to be discussed are gas burners, duct design and air distribution, efficiency testing, panel heating methods, oil burners, cooling and dehumidifying, the heat pump, and electric heating. An exhibition of related manufacturers' equipment will be held concurrently.

Power Conference To Have Heating, Air Conditioning Sessions

The Midwest Power Conference, to be held at the Palmer House, Chicago, March 31, April 1 and 2, is again being sponsored by the Illinois Institute of Technology, 3300 S. Federal St., Chicago, in cooperation with nine midwestern universities and seven engineering societies. A technical session on developments in heating, under the chairmanship of O. J. Prentice, C. A. Dunham Co., is scheduled for 2:00 p.m., Monday, March 31, and the following papers will be presented:

Panel Heating with Air, by H. F. Randolph, vice president, International Heater Co.

Baseboard Radiation Developments, by W. S. Harris, University of Illinois

Losses in the Cycle of a Heat Pump Using a Ground Coil, by R. A. Budenholzer, Armour Research Foundation, Illinois Institute of Technology

A session at 9:00 a.m., Tuesday, April 1, on developments in air conditioning will include papers on:

Compressors for Air Conditioning, by A. B. Newton, chief engineer, Airtemp Div., Chrysler Corp.

Postwar Air Conditioning Advances, by John Herr[illegible]ler, vice president, York Corp.

The session on fuels and combustion, scheduled for 10:30 a.m., Tuesday, will include papers on energy sources of tomorrow and methods of firing pulverized coal. At 2:00 p.m. that afternoon the meeting on power plants will include discussions on power for the paper industry and reduction of air pollution from small boiler plants.

At 9:00 a.m., Wednesday, April 2, a session on the metallurgy of power plants will include a paper on metallurgical considerations in high temperature, high pressure piping layouts and one on materials as a consideration in modern boiler feed pump construction.

E. E. Whitehead, research professor at Illinois Tech, is conference secretary.

Meeting to Cover Latest Methods of Combating Corrosion

The tentative program for the conference and exhibition of the National Association of Corrosion Engineers, which is to be held at the Palmer House, Chicago, April 7-10, has been completed. An extensive program covering the latest developments in combating corrosion has been arranged and it will include eight technical sessions and the presentation of 32 technical papers. Among the many topics to be discussed are the effects of various waters on aluminum, cathodic protection of steel water tanks and turbine pumps, plastics for corrosion control, rust preventive additions, the mechanism of inhibitor action, nondestructive methods of determining metal wall thickness, and a guide to selecting corrosion re-

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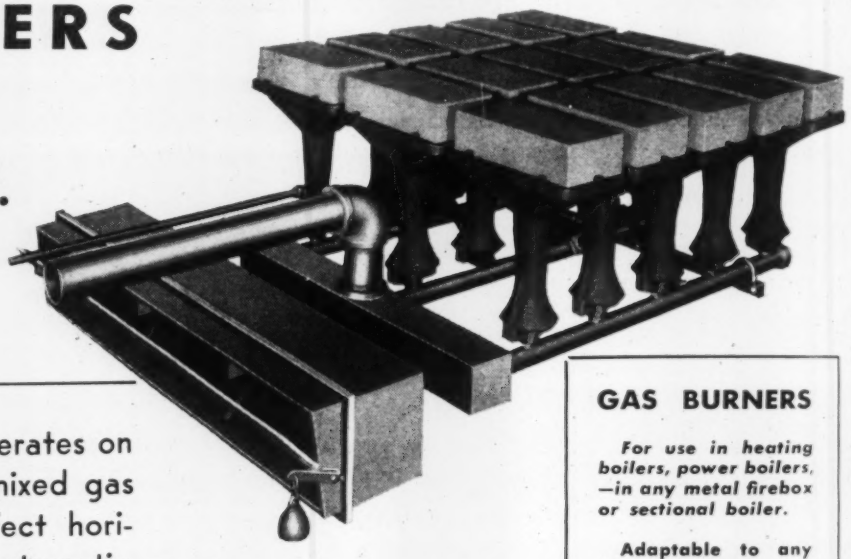

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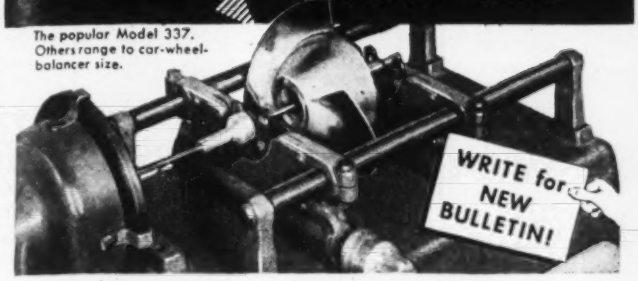

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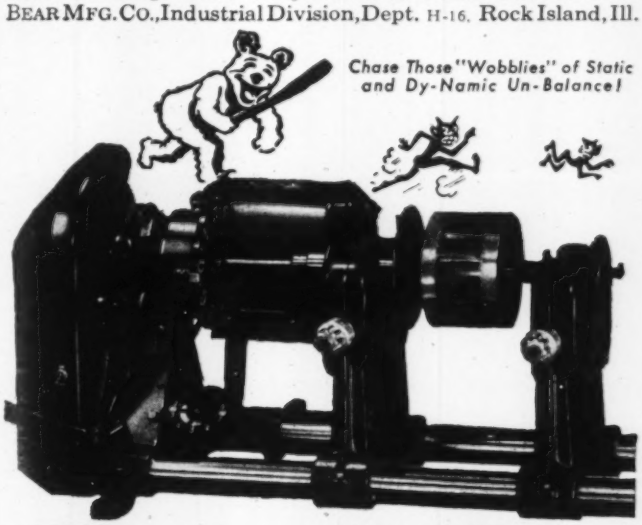

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sistant materials. A. B. Campbell is executive secretary of NACE and headquarters is in the Southern Standards Bldg., Houston, Tex.

ASME Plans Diversified Meetings

The American Society of Mechanical Engineers meeting schedule for 1947 has been announced from national headquarters, 29 W. 39th St., New York City.

The schedule includes:

Oil and gas power 19th national conference, Cleveland, Ohio, May 21-24.

Semi-annual meeting, Chicago, Ill., Stevens hotel, June 16-19.

Applied mechanics 13th national conference, in June, time and place not set.

Fall meeting, Salt Lake City, Utah, Hotel Utah, Sept. 1-4.

Industrial instruments and regulators division, 2nd national conference, Chicago, time not set.

Petroleum mechanical engineering conference, Houston, Tex., Oct. 6-8.

Fuels division, joint meeting with the coal division of the American Institute of Mining and Metallurgical Engineers, Cincinnati, Ohio, time not set.

Annual meeting, New York City or Atlantic City, Dec. 2-5.

ASHVE Schedules June Semi-Annual Meeting

The Del Coronado hotel, Coronado, Calif. (near San Diego), has been selected as the headquarters for the semi-annual meeting of the American Society of Heating and Ventilating Engineers. This year's meeting is scheduled during the week of June 2. A. V. Hutchinson, 51 Madison Ave., New York 10, is society secretary.

ASRE Schedules 1947 Meetings

According to a recent announcement from society headquarters at 40 W. 40th St., New York City, the 34th spring meeting of the American Society of Refrigerating Engineers will be held in Los Angeles, June 8-11. The 43rd annual meeting is scheduled for Atlantic City in early December.

Contractors to Meet in Cincinnati

The Netherland Plaza hotel will be the headquarters of the 58th annual convention of the Heating, Piping, and Air Conditioning Contractors National Association. The meeting will be held in Cincinnati, June 11-14. Association headquarters is at 1250 Sixth Ave., New York City.

Stoker Manufacturers Plan June Meeting

The Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1, has selected Lookout Mountain hotel, Lookout Mountain, Tenn., for its annual meeting which will be held June 16-18.

NDHA Members Schedule Meeting in Atlantic City

The 38th annual meeting of the National District Heating Association will be held at the Chalfonte-Haddon Hall hotel, Atlantic City, N. J., June 24-27. Association headquarters is at 827 N. Euclid Ave., Pittsburgh 6, Pa., and J. F. Collins, Jr., is secretary-treasurer.

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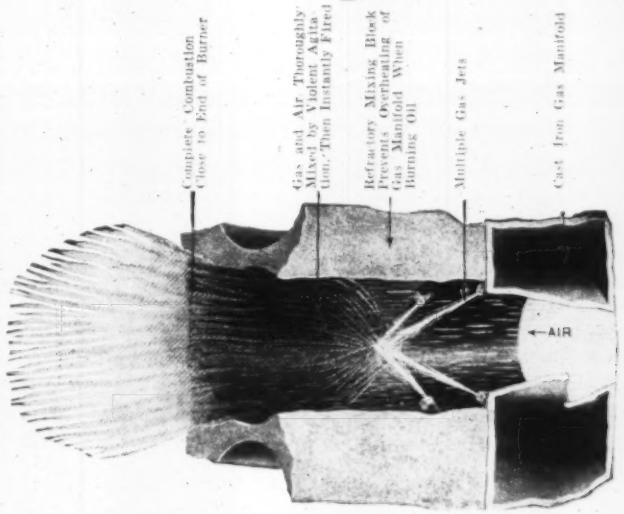
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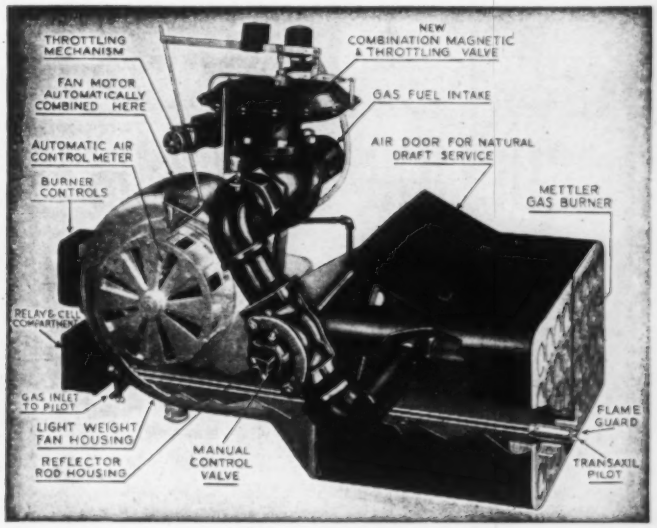

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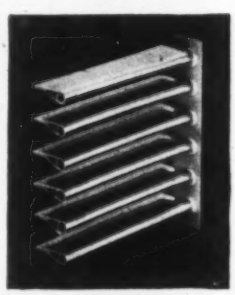

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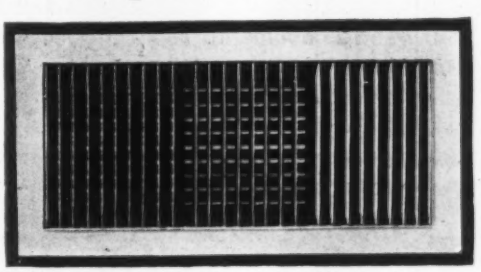

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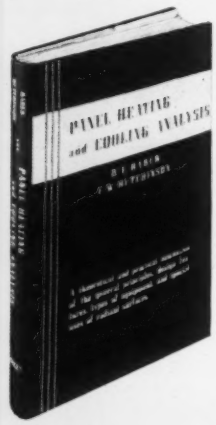

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Activated Carbon Air Freshening

No. 6439—Bulletin 106-A on "Dorex" activated carbon air recovery panels is the latest publication of the W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y. It is said to contain complete data on the design, construction, function, and application of these units. According to the manufacturer, an outstanding feature of the bulletin is the performance chart which provides in one simple tabulation all the data necessary for proper panel selection.

Air Distribution in Schoolrooms

No. 6440—Various heating and ventilating systems, some of the essential design factors, and the importance of proper air motion as applied to schoolroom ventilation and air conditioning are briefly covered in the Vol. 3, No. 1, issue of Aspiration, the house organ of the Anemostat Corp. of America, 10 E. 39th St., New York 16, N. Y. Also included is the second part of an article which deals briefly with some of the fundamentals of fluid flow in ducts.

Arc Welding School

No. 6441—A new pictorial booklet, Learn Arc Welding, has been released by the Hobart Trade School, Inc., Troy, Ohio. The functions of the various courses of study are explained in this 24 page publication which may be obtained from the registrar. Hobart Bros Co., manufacturers of arc welding equipment, is the sponsor of the school, a nonprofit institution.

Asbestos, History and Applications

No. 6442—The story of asbestos—how it was formed, where it is found, how it is mined, and how it is extracted from the mother rock—is graphically told in a 40 page booklet, Asbestos—The Silk of the Mineral Kingdom, published by the Ruberoid Co., 500 Fifth Ave., New York City. The author, Dr. Oliver Bowles, chief of the nonmetal economics division, U.S. Bureau of Mines, also describes present day uses of the material and covers modern methods of manufacturing various important asbestos products such as pipe coverings, insulation, packing, cable coverings, insulating cements, and molded articles.

Ball Bearings

No. 6443—A new bulletin, A-120, describing the new line of SC ball bearings has been issued by the Dodge Mfg. Co., Mishawaka, Ind. Pertinent information cov-

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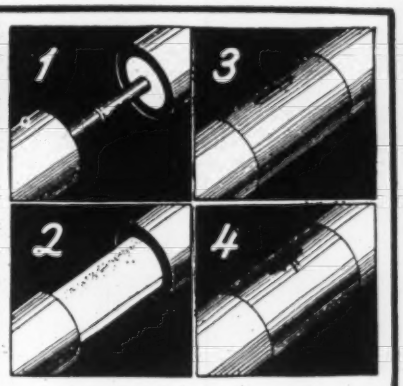

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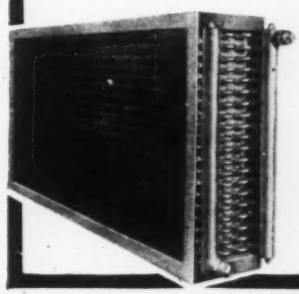

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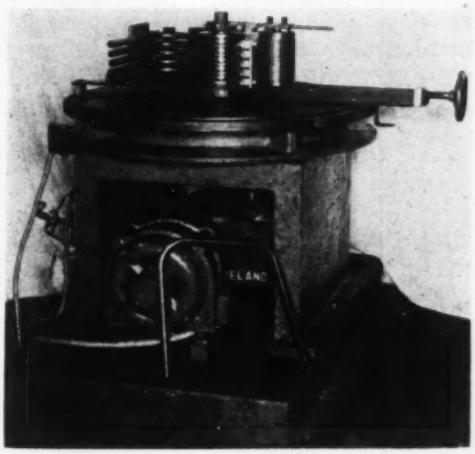

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No. 6444—A four page booklet on the baseboard heating panel equipment of Warren Webster & Co., Camden, N. J., has been released. The heating element, fitting behind a specially built metal baseboard, consists of $\frac{3}{4}$ in. copper tubing with $2\frac{1}{4}$ in. diameter copper fins. The panel is generally installed in a continuous loop around the exposed walls of the room. The baseboard enclosure, consisting of a front piece and an integral upper louver, is made of 18 gage steel.

Blast Coils

No. 6445—"Grid" blast coils are featured in a catalog published by D. J. Murray Mfg. Co., Wausau, Wis. Diagrams of installations, performance charts, physical data, and specifications for these finned heating coils of one piece, cast iron construction are included.

Boiler Construction and Rating Codes

No. 6446—Symbols of Quality is a four page leaflet published by the Steel Boiler Institute, Inc., Land Title Bldg., Broad and Chestnut Sts., Philadelphia 10, Pa., which describes in nontechnical terms the purposes and functions of the ASME boiler construction code and the SBI rating code as applied to the construction, boiler sizes, method of establishing ratings, and test procedures for steel boilers.

Electric Radiant Panel Heating

No. 6447—"Heatsum" cable, developed for supplying heat to electrically heated radiant panels, is described in a four page leaflet and in supplementary mimeographed sheets issued by the manufacturer, L. N. Roberson Co., 1539 E. 103rd St., Seattle 55, Wash. In addition to discussing the merits of radiant heating, the literature provides data on the physical, mechanical, and electrical properties of the cable and briefly covers operating costs and installation procedures.

Gas Fired Heating Equipment

No. 6448—A six page folder covering the company's line of gas-fired heating equipment has been issued by Norman Products Co., 1150 Chesapeake Ave., Columbus 8, Ohio. In addition to conversion burners, gravity and forced warm air furnaces, the folder covers down-blow, gas-fired unit heaters which may be adjusted to deliver heated air in any direction.

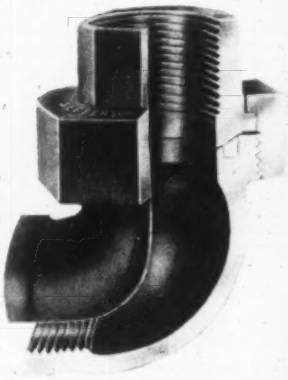
Insulating Varnishes

No. 6449—A 40 page booklet containing technical and application data on insulating varnishes has been issued by the Resin and Insulation Materials Division of the General Electric Chemical Dept., Pittsfield, Mass.

The booklet includes specifications, electrical properties, film properties, cure and aging, chemical properties and baking and air drying cycles of each type. Thirty-six grades are described.

IMPORTANT SAVINGS ON PIPING MAINTENANCE WITH JEFFERSON UNIONS

MAKE BETTER PIPING INSTALLATIONS POSSIBLE



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Low Pressure, Steel Heating Boiler

No. 6450—Low pressure, all welded steel heating boilers are described in a pamphlet issued by Delta Shipbuilding Div., American Shipbuilding Co., Terminal Tower, Cleveland, Ohio. Available in four models, the steam ratings range from 510 to 2500 EDR. Units are designed for all types of automatic firing and for both steam and hot water applications.

Low Temperature Insulation

No. 6451—Mineral wool board insulation for low temperature applications is described and illustrated in an eight page booklet released by the Armstrong Cork Co., Lancaster, Pa. The insulation, made from mineral wool with a waterproof binding agent, is said to have a thermal conductivity of 0.33 Btu per hr per sq ft at 75 F. The mineral fibers are said to be impervious to moisture penetration and the binding agent will not absorb water.

Portable, Hydraulic Pipe Bender

No. 6452—The A-J portable hydraulic pipe bender offered by Wengenroth, 1372 River Rd., West Englewood, N. J., is briefly described in a two page leaflet. The dies and blocks are of all steel construction and are said to be precision turned. The power to bend the pipe is derived from any hydraulic automobile jack of 8 tons or more capacity.

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Pressure Reducing Valves

No. 6453—Bulletin No. 199, issued by A. W. Cash Valve Mfg. Corp., 666 E. Wabash Ave., Decatur, Ill., covers the "Cash-Acme" small volume pressure reducing and regulating valves developed for special installations. Made from brass forgings, the standard valves are designed for initial pressures up to 300 psi and delivery or reduced pressures from 2 to 150 psi. Among the numerous recommended applications are drinking fountains, humidifiers, water coolers, gas refrigerators, air lines, and similar services using water and air. Neoprene diaphragms and "Hicar" seats are available where regulators are to be used where oil or gasoline vapors are likely to be picked up.

Pumps, Motors, and Accessories

No. 6454—Products for Heating, Ventilating, Air Conditioning is the title of a new 12 page booklet issued by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. Briefly described and illustrated are four models of centrifugal pumps, v-belts and sheaves, a-c motors of the squirrel cage, wound rotor, and synchronous types, d-c motors, motor controls, transformers, and a-c and d-c welders.

Radiant Panel Heating

No. 6455—Information on the basic principles of radiant panel heating is contained in a 12 page nontechnical folder, What About Panel Heating, issued by Revere Copper and Brass, Inc., 230 Park Ave., New

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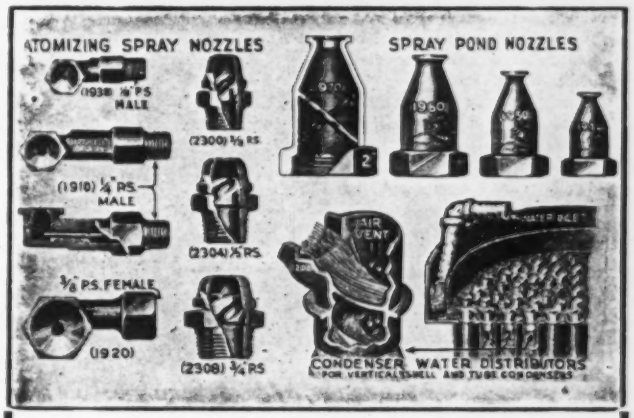

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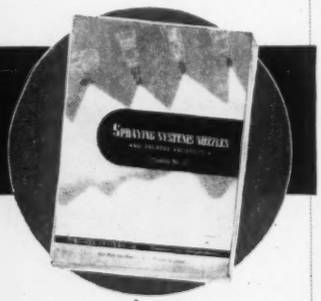

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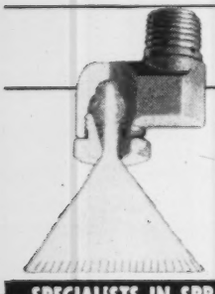

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York 17, N. Y. The leaflet, which is humorously illustrated, briefly highlights the characteristics of this type system—its advantages and disadvantages.

Refractory Walls and Arches for Large Boilers

No. 6456—Sectionally supported refractory walls and arches for industrial and power boilers are described and illustrated in a 33 page catalog (No. C-46) released by Geo. P. Reintjes Co., Kansas City, Mo. Numerous installations are illustrated.

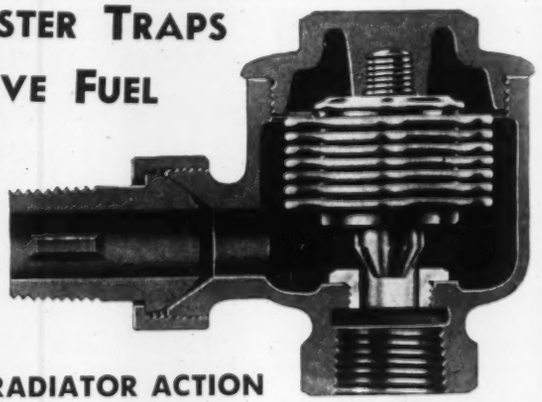
Refrigeration Coils and Cooling Units

No. 6457—Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J., has issued a new edition of its Cooling Units catalog, designated as catalog CD 48. Included in the 20 pages of the booklet are illustrations and descriptions of the many products offered by the company for use in the refrigeration and air conditioning field. Especially valuable to users of finned coils, says the company, is the selection chart for sizing coils for a specific cooling load and a simplified method for determining the price of such a coil.

Room Air Conditioners

No. 6458—Three sizes of room air conditioners are briefly described in a small folder issued by the Carrier Corp., 302 S. Geddes St., Syracuse 1, N. Y. The new units are designed for average size rooms and offices, larger than average size, and extra large rooms and offices.

Nicholson's NEW Line of FASTER TRAPS SAVE FUEL



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BULLETIN 744 describes new traps

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Sheet Metal Brakes

No. 6459—The new 40 page catalog (No. 46-11) issued by O'Neil-Irwin Mfg. Co., Lake City, Minn., gives complete information covering the company's redesigned "Di-Acro" brakes. Many recent improvements in the various models and many "Die-Less Duplicating" applications are described and illustrated. Brakes are offered in four sizes, 6, 12, 18, and 24 in. All models have a material capacity of 16 gage cold rolled sheet steel.

Silicone Products

No. 6460—Dow Corning Corp., Midland, Mich., has recently published the third edition of the DC Silicone Catalog which describes the company's products and various industrial uses for which they are offered. These uses include foam inhibitors, mold lubricants, special lubricants, diffusion pump fluids, varnishes for electrical insulation, greases, and elastic materials for molding, extruding, laminating, and coating.

Storage Tank Preheater

No. 6461—The "Hot Spot" tank heater for heating oil or other heavy bodied substances is described and illustrated in a two page bulletin issued by Rempe Co., 340 N. Sacramento Blvd., Chicago 12, Ill. The heater uses either steam or hot water and is said to fit any bulk tank with manhole opening 16½ in. or larger.

Stud Welding

No. 6462—Designed to provide information on the use of automatic stud welding, a 36 page catalog has

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been released by Nelson Sales Corp., Lorain, Ohio. The company's stud welding process, equipment, and studs are described and illustrated. Information on designing for stud welding is given together with specifications and data on the company's flux-filled studs. Numerous applications are also included.

Temperature, Pressure, and Flow Controls

No. 6463—General Controls Co., 801 Allen Ave., Glendale, Calif., has released a 52 page catalog (No. 52C) covering the company's line of automatic pressure, temperature, and flow controls for gas, air, water, oil, steam, refrigerants, and other fluids. List prices and technical data, including operating pressures, are given.

Temperature Regulators and Controllers

No. 6464—Bulletin No. 464, a 24 page booklet provides engineering, operating, and maintenance data on temperature regulators and controllers manufactured by the Leslie Co., 51 Delafield Ave., Lyndhurst, N. J. Construction details are illustrated and features such as 800 Brinell hardened stainless steel main valves, corrosion resistant springs, stainless steel cylinder liners, and bronze and monel diaphragms are described. Both self-contained and external pilot-operated controllers are covered. Also included are sizing and capacity tables and instructions for installing, operating, dismantling, and cleaning are presented.

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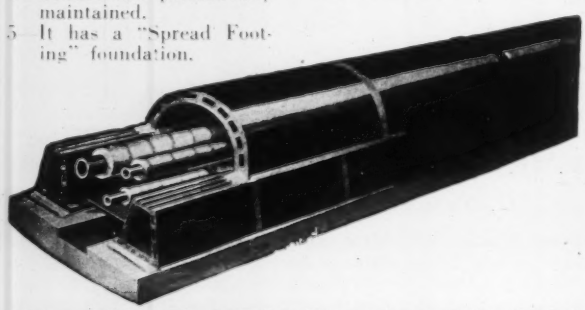

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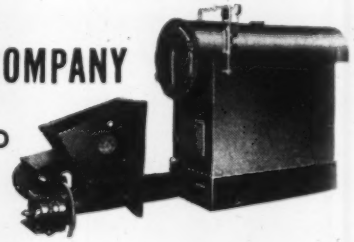

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Underground Piping Protection

No. 6465—The Durant Insulated Pipe Co., 1015 Runnymede St., P. O. Box 88, Palo Alto, Calif., has published a 41 page catalog (No. 5) on its method of protection for underground piping. The protection, applied at the factory, consists of 1 in. minimum thickness of high melting point, nonporous asphalt applied over the piping or insulation. In making field joints, the asphalt is poured hot into a sheet metal form which is spaced concentrically around the pipe or insulation.

Unit Heaters

No. 6466—Details and capacity tables for "Grid" unit heaters, which feature one piece, cast iron heating sections designed for steam pressures up to 250 psi, are contained in a 12 page booklet issued by D. J. Murray Mfg. Co., Wausau, Wis.

Visible, Protective Display Coverings

No. 6467—Transparent plastic holders, covers, envelopes, folders, etc. made from sheets of cellulose acetate are described and illustrated in catalog No. 46 issued by Joshua Meier Co., 36 E. 10th St., New York 3, N. Y. Protective and visible coverings are designed for use with advertising pieces, factory work sheets, data sheets, book and periodical covers, and desk top covers. In addition, special covers may be obtained on order.

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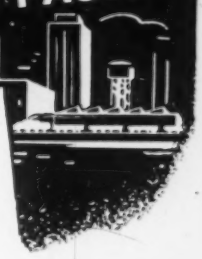

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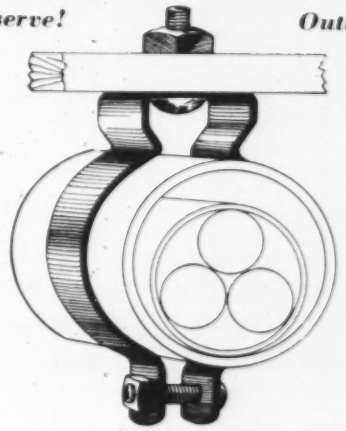

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